MONTHLY WEATHER REVIEW,

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(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to August 20th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 133 Signal Service stations and 15 Canadian stations, as telegraphed to this office; 151 monthly journals and 174 monthly means from the former, and 15 monthly means from the latter; 213 monthly registers from Voluntary Observers; 54 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from the local Weather Services of Iowa, Nebraska and Missouri, and of the Central Pacific Railway Co.; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

The distribution of mean atmospheric pressure over the United States and Canada for the month of July, 1881, is shown by isobaric lines (in black) upon chart No. II. The area of lowest pressure covers the Canadian Maritime Provinces, and the areas of high the Gulf states, Tennessee, the Upper Mississippi and Lower Missouri valleys, and the Northern Pacific coast region. Within the same parallels the pressure is quite evenly distributed over the country east of the 100th meridian. Compared with the preceding month, the pressure is generally higher over the entire country, the increase ranging from 0.01 to 0.13 inch. The regions of greatest change are found in the states bordering the Mississippi river and along the Northern Pacific coast.

Departures from the Normal Values for the Month.—Compared with the means for previous years, the mean pressure of the present month is below the average at all stations east of the boundary formed by the junction of the Mississippi and Ohio rivers, the western line of Pennsylvania and the eastern shores of Lakes Erie and Ontario, and the St. Lawrence river. Westward of this boundary to, and including the Pacific coast regions, the pressure is generally above the mean. Within no district over the country do the departures indicate an unusual variation from the mean, the general range being from normal to 0.10 inch, the latter reported from only two stations, New London and Wilmington, and normal from Galveston, Brownsville, Tex., Punta Rassa, Denison, Tex., Louisville and Denver. The regions of greatest departure, are the Atlantic coast states from Jacksonville to Eastport, the Upper Lake region, Minnesota and California, showing a variation of from 0.04 to 0.10 inch. The regions of least departure are the Gulf coast, Tennessee and the Ohio valley, ranging from normal to 0.02 inch.

Barometric Ranges.—The range of pressure for the month has in general varied from 0.4 to 0.6 inch, and in the extremes from 0.16 inch at Ft. Davis, Tex., to 0.97 inch at Eastport. Throughout the several districts the monthly barometric range varied as follows: New England, 0.74 inch at New Haven to 0.97 inch at Eastport; Middle Atlantic states, 0.52 at Delaware Breakwater to 0.76 at Albany; South Atlantic states, 0.39 at Jacksonville to 0.59 at Macon and Kittyhawk; Eastern Gulf states, 0.26 at Key West to 0.36 at Pensacola; Western Gulf states, 0.25 at Indianola and Galveston, to 0.43 at Ft. Gibson; Rio Grande valley, 0.25 at Eagle Pass, to 0.30 at Brackettville; Ohio valley and Tennessee, 0.35 at Memphis to 0.67 at Columbus; Lower Lake region, 0.50 at Cleveland to 0.67 at Oswego; Upper Lake region, 0.54 at Port Huron to 0.68 at Marquette; Upper Mississippi valley, 0.42 at Cairo, to 0.66 at Des Moines; Missouri valley, 0.58 at Leavenworth, to 0.72 at Ft. Bennett; extreme Northwest, 0.62 at Ft. Buford, to 0.78 at St. Vincent; Northern Slope, 0.44 at Cheyenne, to 0.61 at Ft. Keogh; Middle Slope, 0.35 at Ft. Elliott, to 0.56 at Dodge City; Southern Slope, 0.16 at Ft. Davis, to 0.41 at Ft. Griffin; Northern Plateau, 0.54 at Eagle Rock, to 0.73 at Lewiston; Middle Plateau, 0.41 at Pioche, to 0.54 at Salt Lake City; Southern Plateau, 0.19 at Silver City, to 0.43 at Phœnix; North Pacific coast, 0.49 at Roseburg, to 0.52 at Portland; Middle Pacific coast, 0.37 at San Francisco, to 0.52 at Red Bluff; South Pacific coast, 0.24 at San Diego, to 0.42 at Yuma.

Areas of High Barometer.—Four such areas have been sufficiently important during the month of July, 1881, to merit description.

No. I.—This area, which was partly described in the June REVIEW as high area No. VI, was present in the Upper Lake region on the morning of the 1st as an area of 30.2. Northerly winds prevailed in the Lake region, New England and the Middle Atlantic states, with clear weather, and southerly winds and threatening weather in the South Atlantic states. By the afternoon reports, the winds in the South Atlantic states had shifted to northeasterly, and heavy rains were reported from that district and the East Gulf states, and local rains from the Ohio valley and Tennessee. The temperature fell during the 1st from 4° to 12° at stations in the South Atlantic and Gulf states, and rose slightly in the Lower Lake region. The area moved slowly southeastward during the 1st and 2d, and on the morning of the 3d was central in Tennessee. During the 2d the winds in the Lake region, New England and the Middle Atlantic states backed to southwesterly, and the temperature rose decidedly in all but the latter district, in which it remained nearly stationary. The weather cleared in the South Atlantic and Gulf states, and on the morning of the 3d fair weather prevailed in all districts east of the Mississippi river and in the Northwest. During the 3d the area remained nearly stationary, the pressure increasing slightly in the Gulf states and decreasing slowly, with rising temperature, in the Northwest, and thence eastward to the Atlantic coast. During the 4th the high barometer moved slowly southward, and during the 5th and 6th was central as an area of 30.1 in the Gulf states; after the latter date it ceased to have any marked influence on the weather conditions. The minimum temperatures for the month were caused by this area at many of the stations in the Lake region, the Ohio valley and Tennessee on the 1st and 2d; in the Middle Atlantic states on the 2d and 3d, and in the South Atlantic states on the 3d and 4th. Cautionary signals were displayed on the Atlantic coast from Cape Henry, Va., to Macon, N. C., on the morning of the 1st in anticipation of northeasterly winds. They were lowered at midnight of the 2d, having been partly justified by the following maximum velocities: Cape Henry, NE. 25 miles; Kittyhawk, NE. 34; Cape Hatteras, NE. 28, and Macon, N. 28.

No. II.—On the morning of the 8th low area No. II was central in Manitoba, and the pressures in the Northwest were below the mean—Omaha barometer 0.25 inch below the normal. During the 8th and 9th the pressures rose rapidly in the extreme Northwest and in the Lower Missouri and Upper Mississippi valleys in rear of the depression which moved eastward north of the latter district. The high area moved slowly eastward across the lakes during the 9th and 10th, causing local rains in the Lake region on the 10th and 11th, and in New England on the latter date. The minimum temperatures for the month at stations in the Upper Missouri valley occurred on the 8th and 9th.

No. III.—During the night of the 20th and morning of the 21st the barometer rose rapidly in all districts west of the Mississippi river, and on the afternoon of the latter date an area of high barometer made its appearance in Montana, Fort Shaw barometer 0.27 inch and Fort, Buford barometer 0.26 inch above the mean. Low area No. V was then central in the Upper Mississippi valley near LaCrosse. The pressures west of the Mississippi continued to increase slowly until the 24th, the high barometer remaining nearly stationary. On the 25th and 26th the barometer fell slowly on the Pacific coast but rose slightly in the Northwest, and at the afternoon report of the latter date the high area was central in the Upper Mississippi valley, in which district and in the Lake region the pressures gradually increased until the 29th, when the barometer was above the normal in all districts east of the Mississippi river, excepting the South Atlantic and East Gulf states and the high area became merged in area No. IV, which was then southeast of New England. The minimum temperatures for the month occurred in connection with this area in the Lower Missouri and Upper Mississippi valleys on the 26th and 27th.

No. IV.—At midnight of the 27th the pressures were below the mean in New England and the Lower Lake region, and the Middle and South Atlantic and Gulf states. The pressures increased slowly in the Middle and South Atlantic states and rapidly in New England and the Maritime Provinces during the 28th, and in the two latter districts were slightly above mean at midnight. Easterly winds prevailed in New England and the Maritime Provinces. This pressure continued to increase rapidly in these districts during the 29th, with easterly winds in the former and southwesterly winds in the latter district. Local rains were reported from both districts, followed by clearing weather in the Maritime Provinces during the afternoon, and in New England during the night. The barometer on the morning of the 30th was from 0.3 to 0.4 inch above the mean in New England and the Maritime Provinces, and local rains were reported from the North Carolina coast. The area of high barometer remained nearly stationary southeast of New England during the 30th and 31st, the pressures slowly increasing in the Middle and South Atlantic states, and falling slowly in the St. Lawrence valley and in the Gulf; at midnight of the latter date the barometer was still 0.23 inch above the mean in New England. Rain continued in the Middle and South Atlantic states during the 30th and 31st, clearing in the former district on the 31st. Cautionary signals were ordered on the morning of the 30th from Sandy Hook, N. J., to Macon, N. C. They were lowered from Cape May to Cape Henry at the afternoon report of the 30th; at Atlantic City, Barnegat and Sandy Hook at midnight, and on the morning of the 31st at Kittyhawk, Hatteras and Macon. They were justified by the following maximum velocities: Hatteras, SE. 32 miles; Kittyhawk, E. 36; Chincoteague, E. 25; Delaware Breakwater, NE. 31; Atlantic City, NE. 25 and Sandy Hook, E. 32.

Areas of Low Barometer.—Five such areas have been charted for the month of July, 1881. None of them exhibited special energy.

No. I.—During the 3rd the pressure decreased slowly in the extreme Northwest, and at midnight a depression was central in the Saskatchewan valley; Fort Stevenson, barometer 0.32 inch below the normal. High area No. I, was then central in Tennessee. The temperature had risen in the Northwest, the Lake region, the Ohio valley and New England. Light rains were reported from the Northern Rocky Mountain slope. The depression moved slowly eastward north of the Lakes and at midnight of the 5th was central north of Montreal. Thence pursuing a southeasterly course across New England, it was east of Boston in the morning of the 6th, and had disappeared by the afternoon of the same date. This depression was unaccompanied by precipitation in the Northwest and the Lake region, but caused light rains in New England and the Maritime Provinces on the 5th. Cautionary signals were displayed in advance of this depression at stations on Lakes Michigan and Superior. They were not justified. The maximum temperatures for the month at a majority of the stations in the Middle Atlantic states and southern portion of New England, occurred in connection with this area on the 6th.

No. II—During the 6th the barometer fell decidedly over the Northern Slope and Plateau regions, and in the afternoon an area of low barometer was apparently central in the Saskatchewan valley, although the barometer remained slightly above the mean in all districts in the United States except on the immediate Atlantic coast. Owing to missing reports the track of the depression cannot be accurately charted during the next two days, but the barometer continued to fall in the Northwest, and the depression moved slowly eastward, and at midnight of the 7th was northwest of Fort Garry; Bismarck, barometer 0.45 inch below the normal. On the afternoon of the 8th, it was north of Lake Superior; Duluth, barometer 0.28 inch below the normal. During the 8th, 9th and 10th, it continued its eastward movement north of the Lakes and through the St. Lawrence valley, and disappeared by the afternoon of the 11th.

No. III appeared over the Northern Slope on the 11th and, at the afternoon report, was central near Deadwood; barometer 0.24 inch below the normal. Local rains were reported from stations in the extreme Northwest. Moving slowly eastward the depression was north of Lake Superior on the morning of the 12th; Marquette barometer 0.26 inch below the normal. Heavy rains were reported from the Upper Lake region. It continued to move eastward north of the lakes, causing general rains in the Lake region and occasional thunder-storms in the Mississippi valley; at midnight, it was north of Rockliffe; Kingston barometer 0.16 inch below the normal. Numerous rains were reported from the Middle Atlantic states on the 13th and, at midnight, the depression was west of Chatham, thence it moved eastward off the Atlantic coast. Pressures in the Maritime Provinces remained below the normal until the 18th, when they gradually recovered. No Cautionary signals were ordered for this depression.

No. IV.—On the morning of the 16th a depression made its appearance in the Upper St. Lawrence valley. Its track cannot be accurately charted, but it moved slowly eastward through the Gulf of St. Lawrence during the 16th, 17th and 18th, causing local rains in the Maritime Provinces and New England on all three dates. At midnight of the 19th the weather had cleared and the pressure somewhat recovered in both districts. The barometer, however, remained below the normal in all districts in the United States, excepting the North Pacific. At this report low-area No. IV made its appearance in Ontario, being central north of Rockliffe, barometer 28.58.

Moving southeastward the depression was central north of Montreal, barometer 0.37 inch below the normal. At midnight of the 20th, threatening weather and rain prevailed in New England, the Lower Lake region and the St. Lawrence valley. At midnight of the 21st it was central south of Eastport; barometer 0.37 inch below the normal Continuing to move eastward it was southeast of Nova Scotia on the afternoon of the 22nd. The track of the depression now recurved to the northeastward and it disappeared by midnight of the 23rd, until which time local rains continued in New England and the Maritime Provinces. Cautionary signals were ordered up at midnight of the 20th at Cape May, Delaware Breakwater and Chincoteague. They were lowered on the morning of the 21st, having been justified by maximum velocities of W. 31 miles at Cape May and Delaware Breakwater, and NE. 33 miles at Chincoteague. The latter signal was ordered late.

No. V.—Appeared in Dakota on the afternoon of the 19th, Deadwood barometer 0.37 inch below the normal. The pressures were below the normal at this report in all districts in the United States, excepting the Northern and Middle Pacific coast regions. Moving southeastward the depression was central near Yankton on the afternoon of the 20th; Yankton barometer 0.53 inch below the normal. At this report the winds, in the Northwest and the Upper Lake region, were under its influence and local rains were reported from the Upper Lake region and the Upper Mississippi valley. During the night of the 20th and during the 21st, the depression moved eastward, causing numerous rains in the Northwest and the Upper Lake region, and at midnight of the 21st, was south of Chicago. On the morning of the 22nd, was south of Toledo, and at the afternoon report was west of Norfolk. Thence it moved southeastward; was south of Cape Hatteras on the morning of the 23rd; disappeared by the afternoon report. This depression caused heavy rains in the Ohio valley on the 21st and in the South Atlantic states during the night of the 22nd and morning of the 23rd. Cautionary signals were ordered at Toledo and Sandusky on the morning of the 21st, and lowered at the afternoon report of the 22nd, having been justified by a maximum velocity of E. 28 miles at Toledo. Signals were also ordered up from Kittyhawk to Chincoteague on the afternoon of the 22nd, and lowered on the afternoon of the 23rd. They were justified by the following maximum velocities: Kittyhawk, SW. 32 miles; Cape Henry, NW. 28, and Chincoteague, NE. 27.

INTERNATIONAL METEOROLOGY.

International charts, Nos. V and VI, accompany the present REVIEW. The former is published for the month of May, 1879, continuing the work for that year, which was delayed after the issue of chart No. V for the month of April, 1879, because of an intermission in the publication of the "Beobachtungen auf dem Nordatlantischen ocean" of the "Deutsche Seewarte." The series of this chart are now complete, from January 1877, up to, and including the present date. Chart No. VI is for August, 1879.

Chart No. V shows the mean pressure, temperature and the prevailing direction of the wind at 7.35 a. m. Washington, or 0 43 p. m. Greenwich, mean time, for the month of May, 1879, over the Northern and at certain isolated stations in the Southern Hemisphere. There are two small areas of low pressure, (29.80) for the present month, one situated just north of the Black Sea and the other covering Iceland, Greenland and the surrounding ocean north of parallel 60°. The former area occupies the precise region over which one of the low areas (29.80) of May, 1877, prevailed, while the latter presents a similar comparison with the position of the area of 29.80 in May, 1878. In addition it should be said, that a very small area, 29.60, (the lowest of the month), for May, 1878, lay off the northwest coast of Ireland. The pressure is generally above 29.90 throughout Asia, except in Toorkistan where probably another area of 29.80 exists; along the Asiatic coast the pressure is generally above 29.80, although the prevailing direction of the winds would seem to indicate the presence of such an area over the ocean south of the Kamtchatka peninsula. The pressure over Hindostan ranges from 29.51 at Patna and Deesa to 29.72 at Chittagong. In the United States the area of lowest pressure, 29.90, prevails over Texas and thence northward over the Eastern Rocky Mountain slope to Dakota. In Europe this area covers a small portion of southern France, northern Italy, Austria and southern Russia. The area of highest pressure (30.30), except at isolated stations, covers the Atlantic from 35° to 45° N., and 25° to 45° W. The area of 30.00 is common to the largest extent of territory, covering as it does the greater part of Europe, Algeria, the West Indies, Canada, Hudson's Bay Territory and in the United States, the Pacific coast and that portion of the country lying east of the Mississippi. The following are the highest readings from isolated stations: Angra and Ponta Delgado, 30.28 (769.0); Funchal, 30.15 (765.7); San Luis Potosi, 30.13 (765.2); Cape Town, 30.11 (764.7); Guadalajara, 30.10 (764.4); Mexico and Fao, 30.08 (763.9); Sfax, 30.06 (763.4); Mauritius, 30.04 (762.9). The extreme monthly range of mean pressure is 0.89 inch, which is 0.29 inch larger than in *May*, 1878, and more than double that for *May*, 1877. The lowest mean temperatures, given in Fahrenheit's scale, were reported from the following stations: Ft. St. Michaels, 26°; York Factory, 31°; Godthaab, 34°; Nikolaievsk on the Amoor, 35°; Stykkisholm and Tromso, 42°; Yeniseisk,

44°. The highest mean temperatures were reported from the following stations: Agra, 105°; Allahabad, 104°; Lucknow and Deesa, 103°; Lahore, 101°; Fao, 91°; Manilla, 86°; Free Town and Nukuss, 85°; Bridgetown, 84°. The prevailing direction of the winds was, over the United States, *northeasterly* in the Middle, South Atlantic and Eastern Gulf states; *southeasterly* between the 90th and 100th meridians; elsewhere *variable*. Over the Atlantic ocean south of parallel 40° N., *northeast* east of the 40th meridian and *southeast* to the westward; north of 40° N., *northwest* east of the 40th meridian and *southwest* to the westward. Over Europe the winds were generally from the *north* and *northwest*, shifting to *south* and *southwest* over Italy and Austria. Over Hindostan, *west* and *northwest*, except *south* along the southeastern coast. Along the Asiatic coast, *southeast* to *southwest* and *west*. Compared with *May*, 1877 and 1878, there is very little change in pressure along the Pacific coast of the United States and over that country between the 80th and 100th meridians. Over the Middle Atlantic states, New England and Canada, there has been a rise of 0.05 to 0.20 inch. The temperature west of the 100th meridian compares very closely with 1878, but is from 5° to 10° lower than 1877; eastward to the Atlantic, it is generally lower as compared with either year. Over the ocean comparison can only be instituted with 1878. Between the parallels of 30° and 60° N., there has been a very marked rise in pressure, varying from 0.20 to 0.48 inch, while from 20° to 30° N., there has been a slight fall. The temperature is generally high, except off the western coast of Europe, where the fall is quite sharp. Over Europe the pressure is from 0.05 to 0.20 inch above that for *May*, 1878, while as compared with *May*, 1877, it is lower over the northwestern portion by about 0.05 inch, and over the central and southern portions little or no change. Concerning the temperature, it is from 5° to 10° warmer over northern and eastern Europe than in 1877, but closely compares with 1878; over western Europe there is a decided fall as compared with either year, the decline extending southward into Algeria. Over British India there is a fall in pressure, as compared with either year, of from 0.05 to 0.20 inch, being most marked over the northern Provinces. The temperature, as compared with either year, is generally higher in the central and northern provinces; elsewhere lower. Compared with the mean of the past two years, the following deviations in temperature and barometer are reported from isolated stations: York Factory, +0°.1 and +0.03 inch; Ft. St. Michaels, —3°.8 and +0.23 inch; Godthaab, —2° and —0.14 inch; Stykkisholm, +2° and —0.15 inch; Tromso, +0°.2 and —0.03 inch; Thorshavn, +0°.4 and +0.12 inch; Archangel, +3°.8 and +0.13 inch; Ekaterinburg, +5° and +0.10 inch; Barnaul, —8°.9 and —0.05 inch; Yeniseisk, —4°.9 and +0.07 inch; Nikolaievsk on the Amoor, —0°.7; Valdivostock, +0°.8 and —0.02 inch; Pekin, +2°.8 and —0.07 inch; Zi-Ka-Wei, +0°.5 and —0.03 inch; Tokei, +0°.7 and —0.02 inch; Tashkend, +3°.5 and —0.17 inch; Nukuss, +4°.7 and no change; Fao, compared with 1877 only, +12° and +0.05 inch; Beirut, —0°.5 and +0.02 inch; Mauritius, —2°.6 and —0.03 inch; Ft. Napier, —4° and +0.08 inch; Cape Town, +4° and +0.05 inch; Free Town, —1°.5 and —0.01 inch; Paramaribo, no change and —0.03 inch; Funchal, —0°.2 and —0.05 inch; Ponta Delgado, no change and +0.22 inch; Angra, +0°.1 and —0.26 inch; Bridgetown, +2°.6 and —0.10 inch; Navassa, —1°.6; Medellin, —0°.7; San José de Costa Rica, —3°.1; Mexico, —4° and —0.01 inch; Melbourne, —0°.5 and —0.07 inch; Hobart Town, —10° and +0.08 inch.

Chart No. VI.—This chart displays the tracings of the probable courses of 16 of the principal storm areas of the Northern Hemisphere for the month of August, 1879. The approximate paths of progressive movement are based upon daily simultaneous international observations to the number of over 650, besides a large mass of irregular data which reaches this office in various ways, from the logs of vessels of the Merchant Marine of the North Atlantic ocean. Unusual interest attaches to the low areas of this month, owing to the peculiar course of No. I, but more particularly to the evidences of cyclonic disturbance, as indicated in the characteristic courses of Nos. X and XIII. Concerning the general distribution of storm paths, the following is given: Six storms were confined to the territory of the United States and Canada and the neighboring waters, as included within the meridians of 60° and 100° W. and the parallels of 15° and 50° N. Two originated over the United States, but passed over the ocean to near the main-land of Europe. Two first appeared over the ocean between Greenland and northwestern Europe, passing thence northeastward and disappearing north of Russia. Three formed over the ocean southwest of the British Isles, two of which, after crossing them, passed eastward over central Europe, while the other passed northeastward north of Scotland, and after crossing northern Scandinavia, disappeared over northern Russia. Two formed over southern Russia, taking thereafter an easterly course, and one passed northeastward from the Japan sea to the Aleutian Islands. Of the storms over North America, No. I appeared in Manitoba on the 1st, the area of low pressure extending southward into Kansas, with southerly winds thence northward; Ft. Garry, 29.76, SE.; Pembina, 29.70, S. During the 2d and 3d, passed eastward over the Provinces of Ontario and Quebec attended by light rains and moderate changes in pressure. Morning of the 4th, central over the Gulf of St. Lawrence, with light to brisk winds and occasional rains. 5th, remained about stationary, with slowly rising pressure, developing on the 6th into a very marked depression, the barometer having fallen in the past 24 hours from 0.15 to 0.25 inch. 7th, central off the southwestern coast of Newfoundland; Sydney, C. B., 29.31, SW.; Charlottetown, P. E. I., 29.48, NNW; St. John's, Nfl'd, 29.74, SE. 8th, central over the ocean to the southeast of Newfoundland; in

45° 30′ N., 50° 40′ W., 29.61; at St. John's the barometer rose to 30.12, wind SW. 9th, passed northeastward to near 50° N., 35° W; in 47° 35′ N., 33° 30′ W., 29.57, NW. fair; in 49° N., 30° W., 29.48, SW. fair; in 44° 34′ N., 52° 21′ W. *S. S. Westphalia* encountered violent NNW. storm, high seas; in 48° N., 24° W., 29.74 S., force 7, light rain. 10th, in 49° 30′ N., 28° 35′ W., 29.43, N. fair; in 48° 45′ N., 27° 35′ W., 29.50, S. fair; in 51° N., 35° W., 29.74, NW., force 8, thunder-storm; in 52° N., 31° W., 29.71, NNW., force 7, drizzling; in 46° N., 27° W., 29.51, W., force 3, light rain; in 47° 35′ N., 35° 40′ W., northerly gales, heavy squalls. 11th, central in about 48° N. 18° W ; during the presence of the low area off the western coast of Europe, southeast to southwest winds were superinduced, and occasional light rains prevailed over the British Isles. The southeastward progress of the depression in this latitude was checked on the 11th, and its course turned to the northwestward, probably as the result of the presence of two areas of high pressure, one over central Europe and the other situated to the south of parallel 40° N. During the day, as the storm pursued its peculiar course to the west of the British Isles, extremely violent gales and heavy seas were experienced, several vessels wrecked and many badly damaged; bark *St. Andrew*, from New York for Dunkirk, reported violent hurricane, lost sails and cargo; *S. S. Ilranos*, from Liverpool for New York, reported hurricane from SE. to SW., lasting 10 hours, lost sails, stove bulwarks; *S. S. Reviewer* reported most violent hurricane from SE., shifting to E. and N., with thunder and lightning and torrents of rain, confused sea from all points, lasting 8 hours, barometer fell 0.40 inch in 25 minutes. 12th, central in about 60° N., 30° W.; in 51° 40′ N., 28° 50′ W., heavy westerly gale, high head sea; southerly winds prevailed over the British Isles, with occasional light rains, the pressure slowly rising at southerly stations and falling over Scotland and to the northward; at Stykkisholm, barometer 29.37, SE. rain; in 55° 45′ N., 50° W., 29.66, SE. rain; at Gothaab, 29.74, SW. fair. 13th, central north of parallel 60° N. and between the meridians of 30° and 40° W.; Stykkisholm, 29.33, SE. rain; Gothaab, 29.58, W W. fair; in 54° N., 50° W., WNW., violent hurricane, heavy rain; over the British Isles, the pressure fell generally from 0.05 to 0.15 inch, with SE. to W. winds and occasional light rains. 14th, central north of Iceland, the depression spreading westward over Greenland and Baffin's Bay; Stykkisholm, 29.43, S. rain; Gothaab, 29.39, SSW. foggy; the pressure rose rapidly over the British Isles, winds shifting to westerly with clearing weather. On the 15th the winds at Gothaab and Stykkisholm still remained southerly, with rain at the latter, but rapidly rising pressure at both stations. 16th, conditions changed by the presence of low area No. VII to the southward. No. VII.—During the 10th the pressure fell quite rapidly in the Northwest and Manitoba, and by the morning of the 11th the depression was central in Minnesota; St. Paul 29.75, SE. During the 12th and 13th passed eastward over the Upper Lakes and Canada, and on the morning of the 14th was central north of Quebec; barometer 29.53, NW., rain; Farther Point, 29.84, SW., fair. 15th, probably central over Labrador, thence pursuing an easterly course over the ocean to the south of Greenland. 16th, barometer at Gothaab 29.48, a fall of 0.23 inch in past 24 hours, wind changed from S. to N.; Stykkisholm, 29.85, a fall of 0.15 in past 24 hours, atmosphere calm, wind previously from the south; in 51°, 35′ N., 50° W., 29.57, W., violent gale, heavy rain; in 52°, 25′ N., 31° W., 29.97, SE., cloudy. 17th, central in about 58° N., 40° W.; barometer below 29.60 from Labrador to the meridian of 20° W.; Gothaab, 29.47, S.; Stykkisholm, 29.82, calm; in 54° N., 22° W., 29.49, SE., heavy rain; in 50°, 45′ N., 48° W., 29.56, WNW., violent gale and rain. 18th, central in about 58° N., 30° W.; Gothaab, 29.74, calm; Stykkisholm, 29.66, SE., brisk, fair; in 55°, 35′ N., 14°, 40′ W., 29.51, SW., heavy rain; in 53° N., 34° W., 29.27, SSW. rain; at interior stations, British Isles, the pressure rose considerably, but fell along the western coast, with winds shifting to east and northeast. 19th, central in about 55° N., 20° W.; in 52° N., 36° W.; 29.41, NW., rain; in 50° N., 23°, 40′ W., 29.39, W., gale, fair; in 48° N., 34°, 35′ W., W., gale, heavy rain; the winds at Thershavn and Stykkisholm changed from southeast, to northeast and northwest respectively, with rising pressure; over the British Isles the winds changed from northeast and east to southeast and southwest, with a variation in pressure of from +0.05 to +0.12 inch. 20th, central off the Irish coast; in 50° N., 28° W., 29.35, W., rain; in 49° N., 27° W., 29.35, SW., heavy rain; over the British Isles, cloudy, gloomy or rainy weather with southwesterly winds prevailed, the pressure had fallen at all stations, but particularly along the western coast, where a change of from —0.15 to —0.27 inch was reported. During this day the course of the depression was changed to the north-northeast just as the conditions appeared to be favorable for its crossing the British Isles. This peculiar disposition of pressure in the progressive movement of the central area, viz: to skirt the coast of western Europe, characterized the low area throughout the remainder of its course, which bounded Scandinavia to the west and north. It is of importance to note in connection herewith, that on the 20th an area of high pressure (over 30.00) formed over central Europe, and moved in a parallel course with the low area, to the northeastward. On the 23d this high pressure covered central Russia with an area of over 30.10. 21st, depression central off the west coast of Scotland; in 51° N., 18° W., 29.27, SW., cloudy; Thorshavn, 29.43, NE., fair; Galway, 29.42, S., cloudy; Valencia, 29.43, SSE., misty. 22d, central north of Scotland; pressure fell very rapidly at all northern stations in the British Isles, but rose slowly to the southward with winds shifting from south to southwest and west; lowest pressures as follows: Thorshavn, 29.20, W.; North Unst, 29.22, SW.; Nairn, 29.26, SW.; Sandwick Manse, 29.27, SW.; Ardrossan, 29.33,

SSW. 25d, during the day, and with much diminished pressure, the depression passed northeastward along the western coast of Norway, and on the morning of the 24th was central north of Tromso, barometer 29.24, wind SW; southwesterly winds with falling barometer prevailed over Scandinavia. 25th, central north of the White Sea, the area of 29.40 extending eastward from northern Norway to the meridian of 90° E., and southward to parallel 60° N.; Tromso, 29.25, SW.; Archangel, 29.47, WNW.; Yeniseisk, 29.45, SE.; Barnaul, 29.44, SW. 25th, pressure rose rapidly at all stations above named, but direction of wind remained the same except at Barnaul which changed to northwest. No. IV.—Since the 4th the pressure had been generally below the normal over the United States between the 80th and 100th meridians, with no well defined area of depression. During the 6th a decided fall in barometer took place over Lake Superior and to the northward, followed by brisk southerly winds over Upper Lake region, Tennessee and the Ohio valley. On the morning of the 7th depression was apparently central over Lake Huron; Alpena barometer 0.23 inch below the normal. 8th, central near Quebec with a barometric trough below 29.80 extending southward to Virginia. During this day and the following the depression passed northeastward beyond the Gulf of St. Lawrence, disappearing in a high pressure area then prevailing over the ocean to the south of Greenland. No. VI.—This area developed on the 8th off the North Carolina coast. Only slight evidence of its existence was shown from stations along the South Atlantic coast, the pressure having fallen about 0.04 inch in the past 24 hours. The winds were southwest and west, accompanied by occasional light rains. In the vicinity of 34° N., 70° W., the winds were southeast to southwest, brisk, with rainy or threatening weather; barometer about 29.75. On this date the centres of two other depressions (Nos. I and IV) were located to the north and northwest, one in the lower St. Lawrence valley and the other in about 45° N., 48° W. This disposition of pressure gave existence to a most irregular and peculiar shaped area of low, (29.80) running from near the northwestern coast of Ireland southwestward to latitude 40° N. and thence west-southwest within much narrower limits to the New Jersey and Massachusetts coasts, from which locality it extended northward between the meridians of 70° and 80° W. over Canada and Hudson's Bay. This irregular elongated area of depression was bounded to the north and south by areas of high pressure, over Newfoundland above 30.10, and over the Azores above 30.20. 9th, area central, with more decided form, in about 38° N., 70° W.; in 37° N., 62° W., 29.95, violent SW. gale, heavy rain; in 42° N., 60° W., 29.86, SSE., brisk, heavy rain: in 38° N., 72° W., 29.90, N., brisk, fair; off Cape Hatteras, violent SW. and W. squalls with high seas; along the Atlantic coast from Wilmington to Boston west to northwest winds prevailed with pressures generally below 29.90. 10th, central south of Nova Scotia, but depression extended southwestward below parallel 40° N.; in 39° N., 67° W. 29.82, SW., brisk, fair; along the Middle Atlantic and New England coasts winds shifted to northerly (brisk to high) with rising pressure; off Cape Hatteras bark *Grace Bradley* experienced terrific gale from the north lasting 6 hours, and finally settling into a heavy-northeast gale with tremendous high sea, decks swept of everything. 11th, rain with north to west winds and rising pressure (generally above 30.00) prevailed over the ocean southeast of Nova Scotia; in 41°, 56′ N., 61°, 06′ W., ship *Prince Louis* experienced short hurricane or whirlwind, commenced at east-southeast and shifted suddenly to southwest and then northwest, lasting three hours; lost sails and mast, leaving the ship helpless; two seamen washed overboard; in 41°, 20′ N., 64° W., ship *Antinette* reported violent southeast to northeast gale; vessel foundered at 6.30 p. m. Rain or threatening weather with brisk to high southwest to northwest winds prevailed over the ocean south of Newfoundland on the 14th, during which time several vessels experienced very rough handling and much damage to mast and sail. No. X.—Considerable interest attaches to the development and progress of this depression because of its cyclonic action, the unusually large number of vessels wrecked and the remarkable narrowness of the area of atmospheric disturbance. On the 14th the area appeared to be central over the Caribbean sea, south of Porto Rico; in fact from the disposition of surrounding pressure it appears highly probable that the area originated within this natural amphitheatre formed by the western Antilles to the north, the Lesser Antilles to the east, and the Leeward Islands to the south. Over the ocean north of parallel 20°, an area of high pressure from 30.00 to 30.20 prevailed, and south of parallel 10° an area of 30.00 to 30.10. At Bridgetown, Barbadoes, barometer 29.98, a rise of 0.05 inch in past 24 hours, wind shifted from NE. to E: Fort. de France, Martinique, 29.81, no change in past 48 hours, barometer morning of the 11th, 29.83; San Juan de Porto Rico, 29.95, a fall of 0.07 inch in past 24 hours, wind shifted from SE. to E; in 18° N. 64° W., 29.56, a fall of 0.08 inch in past 24 hours, wind shifted from E. to NE. Stations in advance of the immediate centre of depression reported as follows: Navassa, 29.93 or —0.05 inch in past 24 hours, wind steady from the east since the 1st; Kingston, Jamaica, 30.13 or —0.06 inch in past 24 hours, winds shifted from N. to NW. 15th, probably central south of St. Domingo; San Juan de Porto Rico, 30.01, SE., rain; Ft. de France, 29.87; Bridgetown, 29.96, NE. with increasing force; Santiago de Cuba, 29.97, N., light; Navassa, 29.93, NE.; Kingston, 30.14, NE. 15th, central south of Santiago de Cuba, barometer 29.96, occasional heavy showers fell during the day with squalls from the southeast, at midnight barometer rose to 29.99, atmosphere calm; in 19° 45′ N., 75° 50′ W., S. S. *Pomona* experienced hurricane from NE. to SSW., blowing with great violence, accompanied by heavy cross-seas lasting thirteen hours, after which moderated to a gale with heavy rain squalls; Na-

vassa, 29.90, E.; Kingston, 30.11, SE.; Nassau, Bahamas, 29.87, or —0.12 inch in past twenty-four hours, wind shifted from SE. to N.; Grand Turk, Bahamas, 29.90, or +0.15 inch in past twenty-four hours, winds shifted from NE. to SE.; twenty miles east of Watling's Island, Bahamas, brig *Dashaway* had severe hurricane from NE. to SE. and S., lasting ten hours. 17th, central north of Nassau, barometer 29.86, S., heavy rain; Grand Turk, 29.90, SE., strong; Santiago de Cuba, 29 92, NE., fair; Navassa, 29.90, NE., cloudy; Havana, 29.88, or —0.05 inch in past twenty-four hours, atmosphere calm, wind previous day from the SE.; at all Florida stations the winds shifted from SE. and E. to N. and NW., with falling barometer. At this point it is of interest to call attention to the comparatively slight changes in pressure at all stations heretofore named, indicating their position as on the outskirts of the depression which was previously referred to respecting its narrow diameter. During the 17th the depression passed northward in a course curving slightly to the east, path about two hundred miles off the Florida and South Atlantic coasts. 17th, in 31° 45′ N., 79° W., schooner *C. Berry*, about 11 p. m., struck terrific hurricane from NNE., accompanied with tremendous sea and rain; in 41° N., 68° W., S. S. *Metcalf*, violent hurricane from SE., veering suddenly to NE., lasting three hours; in 31° N., 78° 30′ W., 10 p. m., schooner *Drummond* struck cyclone accompanied by heavy cross-seas, vessel on beam-ends for two hours; in 29° N., 78° 30′ W., hurricane from SSE., decks swept. 18th, 6.30 a. m., central on the North Carolina coast, Cape Lookout 29.15 or 0.84 inch below the normal, wind SE., 138 miles per hour; at other coast stations the wind velocities ranged from 68 to 100 miles per hour. In 32° N., 72° W., hurricane from SSE. to WNW, lasting twelve hours and blowing fearfully in squalls. About 200 miles north of Chincoteague, S. S. *Johns Hopkins*, reported the following observations: 12.30 p. m., 29.95, SSE; 1 p. m., 29.80, SE. and S., brisk; 1.30 p. m., 29.65, ESE., gale; 2 p. m., 29.05, E., gale; 2.30 p. m., 28.90, calm for twenty minutes; 2.45 p. m., barometer rising, wind NNW. with great fury; 5 p m., moderate weather. S. S. *Lord Clive*, in about 39° N., 73° W., 8 a. m., 30.02, rain; 10 a. m., 29.90, ENE., light: noon, 29.80, strong breeze, heavy rain, rising sea; 2 p. m., 29.60, NE., tremendous high sea; 3 p. m., slowed engines and put ships head to the eastward; 4 p. m., 29.44, NNE., hurricane, blinding rain, high confused sea; 5 p. m., 29.60, wind suddenly flew into the NW. with fearful violence and high cross-seas; 6 p. m., ditto; 8 p. m., gale moderating, clear to the NW., sea going down, ships head put to the westward; 9.30 p. m., Absecum Light abeam, sea moderating; midnight, 29.90, moderate west breeze. About 15 miles NE. of Cape Henlopen, schooner *Sea Bird*, 5.30 p. m., struck hurricane and was carried 50 miles south. Ten miles south of Vineyard, schooner *Skylark* encountered heavy gale from E., veering around to NW., in which vessel scud under bare poles for thirteen hours. Off Chincoteague, S. S. *Lucretia*, NE. veering to NW. violent gale, heavy rains and high seas. About 30 miles SE. of Five-fathom Bank Lightship, bark *E. J. McManerray*, from Havana to New York, August 20th, experienced fine weather to the 18th, when barometer began to fall rapidly, wind SE., rain in torrents; 2 p. m., wind ceased at SE. leaving a terrific sea, suddenly wind came from NNW., carrying away portion of masts and sails; for two hours vessel in a perfect cyclone and literally submerged. Twenty miles east of Sandy Hook, violent hurricane from ENE. to NW., lasting eight hours. Off Nantucket, violent SE. gale, lasting ten hours. Forty miles east of Cape Cod, heavy NE. gale, lasting eight hours. Thirty miles off Sandy Hook, S. S. *Reindeer*, heavy NE. gale, lasting eight hours, lost masts and bulwarks, decks completely under water for five hours. 19th, 7.35 a. m., central south of Eastport, barometer 29.30, or 0.70 inch below the normal, lowest, 29.16 at 11.15 a. m., wind NE., 34 miles; the winds along the New England coast veered from E. to S. and NW., with velocities ranging from 25 to 60 miles per hour. In 38° 29′ N., 74° 16′ W., S. S. *Holbrook* encountered the end of a hurricane, wind blowing from NW. to NE., changing suddenly, sea terrific, decks swept. Thirty miles S. of Gay Head, near Vineyard Haven, 6 p. m., hurricane, carrying away sails and small boats; lay to for about two hours with lea-rail under water and sea washing deck. In 42° 50′ N., 67° 45′ W., schooner *J. W. Nickerson*, terrific cyclone for sixteen hours. In 42° 38′ N., 65° 20′ W., S. S. *Memento*, revolving gale from SW. to NW. with heavy cross-seas, lasting twelve hours. In 41° N., 65° 56′ W., violent SW. gale and high seas for twenty hours. Sixty miles S. of Cape Sable, fearful SE. gale, decks swept. In 34° N., 73° 30′ W., terrific gale from ESE. to NW. In 42° N., 63° W., violent SW. to W. and NW. gale and high seas. In 42° N., 79° W., violent SE. to SW. and W. gale, tremendous high sea. 20th, 7.35 a. m., central south of Newfoundland, depression slowly filling up. From Maine eastward to Cape Breton Island the winds were NW. and N., pressure ranging from 29.54 to 29.90, lowest at Sydney, C. B.; over Newfoundland and southeastward to 50° W., winds, SE., barometer 29.76 to 29.94. 21st, passed eastward beyond 50° W., combining with an area of 29.80, then prevailing over the ocean in the region of parallel 50° N. and forming a part of low area No. VII, then central off the Irish coast.

No. XII.—With the pressure below the normal over the Southeast Rocky Mountain slope and Texas since the 13th, the area appeared central in Indian Territory on the morning of the 15th; thence its course was northeastward over Tennessee and the Ohio valley to central New York, where on the morning of the 17th it appeared to be about stationary, with NE. to SE. and S. winds and rain along the Middle Atlantic coast. On the 18th, these winds had changed to N. and NW., with a slight rise in pressure, rain continuing, but more general and heavy, owing to the

advance of low area No. X, then on the North Carolina coast. No. XIV.—On the 20th, from the Saskatchewan valley southward to New Mexico, an area of low pressure, generally below 29.80, prevailed. By the 21st this area had taken more decided form and was central in Minnesota, lowest barometer at Breckinridge, 29.54. 22d, central over Lake Michigan, Escanaba 29.52, or 0.42 inch below the normal. During the 23d and 24th depression remained about stationary in the Lower St. Lawrence valley, accompanied by light rains and east to south winds, fresh to brisk. 25th, depression passed southeastward off the Nova Scotia coast, followed over the Maritime Provinces by NE. to NW. winds and rising pressure. No. XIII.—This storm, like No. X, possesses throughout portions of its course the characteristics of a tropical cyclone, but lacks decidedly in the extraordinary power manifested by the latter. On the 20th, the pressure fell over the southern portion of the Gulf of Mexico as indicated by the barometer readings at Havana and Tlacotalpam, the former 29.87, and the latter 29.85, a fall at both stations of 0.02 inch in past twenty-four hours. Fifty miles east of Alacran Reef, off the northern coast of Yucatan peninsula, bark *Elvina* encountered violent cyclone from ENE., which ended on the following day at 4 p. m., with wind SSE.; very high seas and terrific squalls were experienced as the vessel passed to the westward; considerable damage was reported from the vicinity of Progresso on the northwestern coast of Yucatan, and also along the Bay of Campeachy. 21st, pressure fell considerably at all Gulf stations, and high NE. to NW. winds were anticipated along the northern coast. At Tlacotalpam barometer 29.79, a fall of 0.06 inch in past twenty-four hours, wind shifted from N. to W. with heavy rain, 2.37 inches in past twenty-four hours. 22d, central south of Galveston, the pressure falling rapidly along the northern Gulf coast, giving a variation of from —0.15 to —0.24 inch in past twenty-four hours; the rainfalls were unusually heavy and the winds mostly from the north, increased to high. 23d, central in eastern Texas, where the pressure was generally below 29.50, lowest barometer at Shreveport, 29.31; very heavy rainfalls, but no dangerous winds, so far as reported, accompanied the progress of the area on this day. During the 24th and 25th, the depression passed northeastward over Tennessee and the Ohio valley, accompanied by quite decided changes in pressure, northeast to northwest winds and occasionally heavy rains. On the morning of the 26th central on the North Carolina coast, where brisk to high NW. to SW. winds were reported, pressure generally below 29.80. During this day and the following passed eastward to near the 70th meridian and thence northeastward to parallel 40° N. 28th, in 38° N., 71° W., 29.92, NE., high, fair; in 40° 30′ N., 67° 40′ W., 29.90, E., high, heavy rain; in 43° N., 64° 45′ W., 29.95, NE., brisk, fair. 29th, central south of Nova Scotia, with SE. to N. winds and rain over the Maritime Provinces. In 42° 30′ N., 63° 45′ W., 29.65, NE., rain; in 40° 35′ N., 66° 25′ W., 29.92, NNW., fair; in 41° N., 62° W., 29.75, SW. gale, thunder-storm; in 43° N., 60° W., 29.76, SSW., brisk, rain and lightning; in 40° N., 69° W., 30.10, NW. gale. During the 30th and 31st, passed northeastward south of Newfoundland, combining with an area of 29.80, then prevailing over the ocean in the vicinity of parallel 50° N. Of the storms confined to the ocean northwest of the Britsh Isles, No. II appeared on the 1st in about 60° N., 10° W.; Thorshavn, 29.66, NE.; Stykkisholm, 29.93, NW.; Sandwick Manse, 29.54, W. 2d, central north of Scotland; Thorshavn, 29.47, N.; Sandwick Manse, 29.95, WSW.; pressure rose rapidly over northern Scotland, with winds shifting to SW. During the passage of this storm northeastward, the pressure remained generally above 30.00 over the central and southern portions of the British Isles, with clear or partly cloudy weather and W. to NW. winds. During the 2d, depression passed rapidly northeastward along the western coast of Norway, affecting the pressure very slightly at coast stations, and on the morning of the 3d appeared to be central north of Scandinavia; Tromso, 29.94, a fall of 0.10 inch in past 24 hours, wind S., rainfall 0.76 inches in past twenty-four hours; during the day area disappeared to the eastward. No. XVI.—After the passage eastward over northern Scandinavia of area No. XV, the pressure during the 29th again fell to the westward in the vicinity of Iceland, barometer at Stykkisholm, 30th, 29.57, a fall of 0.13 inch in the past twenty-four hours. On the morning of the 30th, area probably central southwest of Iceland; Godthaab, 29.80, S., rain. 31st, depression probably passed northeastward between Greenland and Iceland; Stykkisholm, 29.29, S., about 40 miles per hour; Godthaab, 29.72, N., about 40 miles per hour. During the day area disappeared over the Arctic Ocean. Of the storms over Europe No. III appeared off the northwestern coast of France on the 5th; pressure generally below 29.80 northeastward to northern Norway, with occasional light rains: 6th, central over southern Scotland; Siloth Rectory, 29.47, NW., cloudy; Glasgow, 29.48, WNW., threatening; Ardrossan, 29.49, NW., cloudy; Aberdeen, 29.52, ENE., cloudy; Nairn, 29.54, NE. rain. The variation in pressure at British stations in the past twenty-four hours ranged from 0.15 to 0.27 inch. 7th, central over the North Sea, near parallel 60° N.; diameter of depression very narrow; changes in pressure in past 24 hours were reported as follows: Brono, —0.20 inch; Christiania, —0.09; Bergen, —0.08; Aberdeen, +0.03; Nairn, +0.05; Vestervig, +0.07; Ardrossan, +0.18. 8th, central over southern Sweden; Wisby, 29.50, NNW.; Upsala, 26.60, ESE.; Christiania, 29.65, NNW., rain; over Denmark and the southern shores of the Baltic the pressure was generally 29.80 and below, with SW. to NW. winds; southeast of the Baltic, in Russia, the winds were SE. to SW., with occasional light rains. 9th, depression about stationary, with slowly falling barometer; Upsala, 29.39, E., rain; Stockholm, 29.41, WSW., rain; Christiania, 29.51, NW., cloudy; pressure falling slowly over eastern Russia,

with occasional light rains and SE. to SW. winds. 10th, central near the Gulf of Riga; Wisby, 29.55, NNW., about 40 miles per hour, rain; Upsala, 29.59, ENE., rain; Stockholm, 29.56, E., rain; Memel, 29.48, west, violent gale, about 70 miles per hour, accompanied by rain; Königsberg, 29.34, W., violent gale, about 60 miles per hour, with rain; over Denmark, Prussia and along the southern coast of the Baltic, high N. and NW. winds, with occasional heavy rains, prevailed throughout most of the day; in eastern Russia barometer still falling, with rain and S. to SE. winds. 11th, central over eastern Russia, near Wilna; barometer, 29.38, a fall of 0.21 inch in past 24 hours; over Denmark and Prussia the winds still remained westerly, but with greatly diminished force, while along the southern coast of the Baltic they had changed to north, with heavy gales; pressure fallen throughout Russia. 12th, central near Moscow; barometer, 29.19, a fall of 0.49 inch in past 24 hours. During this day and up to the 18th the depression remained over central and western Russia, with a sluggish movement to the eastward. On the 13th the pressure rose abruptly to about 29.60, which condition was maintained with considerable variability until the depression crossed the western border of Siberia on the 18th, when it rose on the following day at Ekaterinburg from 29.55 to 29.76. 19th, central in the valley of Obi near 60° N., 80° W.; Barnaul, 29.39, SW.; Yeniseisk, 29.31, E., a fall of 0.59 inch at the former, and of 0.27 inch at the latter station in the past 24 hours. 20th, probably central over the Province of Iakoutsk; Yeniseisk, 29.47, W. rain; Barnaul, 29.65, W. fair. The further course of this area could not be traced, owing to lack of reports from eastern Siberia, although it is believed that the depression reached the Asiatic coast, probably in the vicinity of Nikolaievsk on the Amoor; the barometer fell steadily at coast stations from the 19th to the 22d. No. XI.—This area was probably a secondary development from area No. I during the existence of the latter over Iceland on the 14th, as on that day an area of 29.80 extended southward to the 55th parallel west of the 10th meridian, and on the 15th reached the northwest coast of Ireland. Galway, 29.78, SE. rain; Armagh, 29.88, ESE.; over Scotland, northward to Thorshaven, the winds were from the E., and pressure generally above 29.90. 16th, pressure fell below 29.80 at all British stations except Valencia, the area extending southeastward into Austria, with occasional rains and variable winds; no well defined centre of depression. 17th, area developed more decidedly, and was probably central over the southern portion of the North Sea, followed by NE. to NW. and SW. winds over the British Isles; Bolton, 29.42, NE.; Bidston, 29.45, WNW. rain; Leicester, 29.45, W. rain; Silloth Rectory, 29.45, W.; along the eastern and southeastern coasts of the North Sea the winds were S. and SE., with the barometer generally below 29.70. During the 18th and 19th the depression nearly lost its identity over central Europe, owing, probably, to the rapid advance and large extent of area No. VII, which neutralized the effects of the moderate depression there central by an indraught of air from the south and east, which nearly restored the atmospheric equilibrium. During the 18th rain fell at nearly all stations throughout Germany and Austria, with the pressure generally below 29.90. On the 19th occasional rains, with rising pressure prevailed, except at Hermannstadt and Lemberg, where the barometers were respectively 29.76 and 29.73. 20th, probably central north of the Black Sea; Kieff, 29.53, E; Nikolaiev, 29.68, SSW; Lugan, 29.62, ENE. During the 21st, probably central over the Caspian Sea; Nukuss 29.48, a fall of 0.16 inch in past 24 hours, wind ENE; Tashkend, 29.58, no change since the preceding day, wind NW. 22nd, probably central over Toorkistan; Nukuss, 29.43, NE; Tashkend, 29.55, N; on this day the area of 29.60 extended northeastward from Russia to central Siberia; Barnaul, 29.49, a fall of 0.18 inch in past 24 hours. 23d, depression about stationary, lowest barometer at Tashkend, 29.51; at Barnaul the barometer rose to 29.70, wind NW. 24th, probably central over the eastern portion of the Province of Omsk; Barnaul, 29.45, SE; Tashkend, 29.73, calm. 25th, probably central in the valley of the Yenisei; Barnaul, 29.44, SW.; Yeniseisk, 29.45, SE., rain. 26th, very probably combined with a large area of 29.60, then prevailing north of the 60th parallel and between 20° W. and 90° E. No. XV.—The pressure over the British Isles and to the westward did not recover rapidly from the passage of area No. VII, because of its very slow movement from the 20th, when off the Irish coast, to the 25th, when it disappeared north of Scandinavia. On the 25th the pressure fell over the northern portion of the British Isles, from 0.35 to 0.50 inch, with SE. to SW. winds, and occasional rains, but the lowest pressure remained off the western coast; in 55° N., 15° W., 29.22, WSW. rain. During the 26th and 27th, area probably central near the Hebrides, with NE. to NW. winds, falling barometer, and occasional rains over Scotland; barometer fell gradually from the sudden change on the 25th. 27th, in 53° 40′ N. 14° W. 29.05, SW. fair; Monach Lighthouse, 29.09, SE; Ardrossan, 29.10, S; pressure over the British Isles generally below 29.30, with rain at every station but three, where it was reported as cloudy or threatening; over the southern portion the winds were southwesterly, with heavy gales along the Irish coast, and over the English channel. 28th, central north of Scotland; Thorshavn 28.95, NE. rain; Monach Lighthouse, 28.95, S; in 53° N. 14° W. 28.89, WSW.; Galway, 29.02, WSW. violent gale; Sandwick Manse, 29.02, SW; along the Norway coast the pressure ranged from 29.10 to 29.30, with S. and SE. winds and occasional rains; the area of 29.80, extended from Greenland southeastward, to central France, and thence northeastward to northwestern Siberia, thus inclosing the whole of northwestern Europe; the area of rain extended northeastward from western France to Finland with south and south-

west gales ranging from 25 to 60 miles per hour. 29th, central off the western coast of Norway; Brono, 28.86, SW., rain; Tromso, 28.96, SW.; Umea, 28.93, SW.; Hernosand, 29.00, WSW.; Christiania, 29.02, SSW.; the pressure over the British Isles rose from 0.20 to 0.50 inch with winds shifting to west and northwest with occasional light rains and generally cloudy weather; violent westerly gales continued over the English Channel, North Sea and the Baltic; the area of 29.80 covered the whole of northern Europe. During the day the depression passed eastward over northern Scandinavia followed by rapidly rising pressure and north to west winds, being central morning of the 30th over the White Sea; Archangel, barometer 29.01, NNE; over central Russia pressure generally below 29.60 with southeast to southwest winds and occasional rains; Ekaterinburg, 29.49, heavy rain. 31st, central in western Siberia; Ekaterinburg, 29.41, WSW., threatening; the pressure was generally below 29.60 over northern Russia with southwest to northwest winds. Of the storms forming over Russia No. V developed over the region north of the Caspian Sea. On the 6th there was a sudden fall in barometer of from 0.07 to 0.15 inch and the circulation of winds, with the accompanying pressure at surrounding stations, is given, as follows: Ekaterinburg, 29.56, E.: Kasan, 29.43, NW.; Krotkowo, 29.39, N.: Astrakhan, 29.56, N.; Nukuss, 29.52, WNW. During the 7th and 8th depression remained central over the province of Omsk; 7th, Krotkowo, 29.43, N., rain; Kasan, 29.49, N.; Barnaul, 29.38, ENE.; Nukuss, 29.73, WSW.; Tashkend, 29.62, calm. 8th, pressure rose from 0.05 to 0.21 inch at all stations. 9th, a fall of 0.09 inch was reported from Barnaul, atmosphere calm, followed on the 10th by another fall of 0.12 inch, wind SSW., cloudy, and at Yeniseisk, of 0.25 inch, wind S., rain. During the 10th passed northeastward beyond the Yenisei, followed on the 11th by rising barometer and SW. winds, rain still continuing at Yeniseisk. No. VIII.—After the passage of area No. III, the pressure still remained low north of the Black Sea, forming on the 13th a slight depression in the vicinity of Kieff, barometer 29.41. W. From the 14th to the 16th, depression remained about stationary over the region between the Black and Caspian seas, finally disappearing on the 17th by the encroachment of a high pressure from central Europe. Only one area for the month has been charted off the Asiatic coast. No. IX.—On the 12th the isobar of 29.80 generally covered the Japan Islands, accompanied by SE. to SW. winds, and on the 13th a fall of from 0.07 to 0.18 inch was reported, the depression appearing to be central over the Japan Sea. 14th, probably central south of the Island of Yesso; in 41° N., 152° E., 29.36, S., rain; in the vicinity of Yeddo the barometer fell about 0.10 inch, with winds shifting to westerly. 15th, probably central south of Kamtchatka peninsula; in 43° N., 158° E., 29.43, S., threatening; in 39° N., 144° E., 29.63, SW., fair; the winds over the Japan Islands generally shifted to N. and NE., with a slight rise in pressure. 16th, in 45° N., 164° E., 29.48, W., cloudy. 17th, in 46° 30′ N., 170° 45′ E., 29.42, S.; in 52° N., 175° 40′ E., calm, clear. 18th, in 47° 39′ N., 178° 21′ E., 29.74, S., fair; in 52° N., 175° 40′ W., SE., cloudy. 19th, in 48° 11′ N., 174° 03′ W., 29.87, S., cloudy; in 52° N., 175° 40′ W., SW., fair. 20th, depression disappeared in a high area then prevailing to the south of Alaska: in 48° 11′ N., 166° 03′ W., 30.05, SW., foggy.

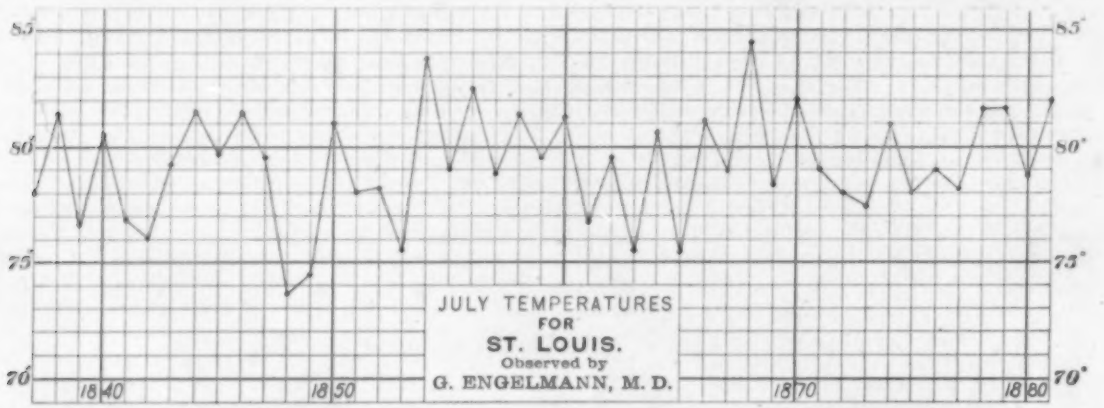
TEMPERATURE OF THE AIR.

The mean temperature of the air for July, 1881, is shown by the isothermal lines (in red) on chart No. II. The table of mean and comparative temperatures in the right hand corner of the chart shows, in the first column, the average for the month throughout the various districts, as deduced principally from observations taken at Signal Service stations. In the two remaining columns are shown the means for the present month, and the departures of such means from the average for many years. Throughout the entire country west of the 107th meridian, the mean temperature of the month is from 1°.9 to 4°.3 below the normal. Eastward of this meridian, except in New England, there has been a general increase in every district over the average mean temperature for many years, being most marked over those States lying between the 82° and 90th meridians, where the excess ranges from 1°.7 to 2°.0. It is interesting to note that this elongated region of high mean temperature lies between thermometric normals in the Middle Atlantic States to the east and in the Mississippi valley to the west. The departure from normal over the whole of the Eastern Rocky Mountain slope, shows a gradual transition from the area of deficiency to that of excess.

Ranges of Temperature at Signal Service stations.—Monthly ranges in general varied from 35° to 40° over the country east of the Rocky Mountains, and from 40° to 50° to the westward of that region. The *smallest ranges* were: Port Eads, 18°; Key West and Punta Rassa, 19°; Indianola, 20°; New Orleans, 21°; Galveston, Thatchers Island and San Diego, 22°; Macon and Brownsville, 23°; Cape May and Cedar Keys, 25°. The *largest* were: Dayton, 62°; Fort Keogh, Fort Buford and Rock creek, 61°; Fort Benton, 60°; Fort Assinaboine and Missoula, 59°. The *daily ranges* varied in the different districts as follows: New England, 16° at Thatchers Island to 31° at Burlington; Middle Atlantic states, 16° at Cape May to 31° at New York and 33° at Norfolk; South Atlantic states, 16° at Macon to 28° at Augusta; Eastern Gulf states, 16° at New Orleans and 17° at Key West and Punta Rassa to 32° at Vicksburg; Western Gulf States, 13° at Port Eads and 18° at Indianola to 31° at Denison and Fort Gibson; Rio Grande valley, 29° at Rio

Grande City, Laredo and Brackettville to 34° at Eagle Pass; Ohio valley and Tennessee, 24° at Memphis to 30° at Pittsburg and 33° at Nashville; Lower Lake region, 19° at Erie to 22° at Cleveland and 30° at Oswego and Rochester; Upper Lake region, 18° at Grand Haven to 31° at Marquette and Port Huron and 32° at Duluth; Upper Mississippi valley, 22° at La Crosse to 29° at St. Louis and 31° at St. Paul; Missouri valley, 25° at Omaha to 37° at Fort Bennett; Extreme Northwest, 33° at Moorhead to 42° at Bismarck and Fort Buford; Northern Slope, 31° at North Platte to 47° at Fort Keogh; Middle Slope, 27° on Pike's Peak to 33° at Denver and 37° at Dodge City; Southern Slope, 30° at Henrietta and Jacksboro to 41° at El Paso and 50° at Davis; Northern Plateau, 39° at Lewiston to 45° at Boise City and 49° at Missoula; Middle Plateau, 34° at Pioche and 36° at Salt Lake City to 49° at Winnemucca; Southern Plateau, 31° at Santa Fè to 42° at Florence and Fort Verde; North Pacific coast, 33° at Portland to 38° at Olympia and Roseburg; Middle Pacific coast, 24° at San Francisco to 38° at Red Bluff; South Pacific coast, 20° at San Diego to 44° at Visalia and 56° at Campo.

Deviation from Mean Temperatures.—Illinois: Riley, mean temperature 72°.5, or 1°.7 above the mean of the past 20 years; the years 1866, 1868, 1870, 1874 and 1878 were warmer. *Maine:* Gardiner, mean temperature, 2°.8 below the mean of past 45 years; there have been four instances of a colder July, viz.: in 1844, 1855, 1858 and 1860. *Missouri:* St. Louis, Missouri



Weather Service reports: mean temperature, 82.°0, or 2°.8 above the mean of the past 45 years; higher mean temperatures were recorded in 1854, 1856, 1868. *New Hampshire:* Contoocookville, mean temperature, 0°.5 below the mean of the past 11 years. *New York:* North Volney, mean temperatere 0°.02 below the mean of past 13 years; warmest July occurred in 1868, mean 76°.2; coldest July occurred in 1865, mean, 66°.1. *Ohio:* Bethel, mean temperature, 3°.1 above the mean of past 50 years. *Texas:* Clarksville, warmest July in past 13 years.

High Temperatures.—From the following data, it will be observed, that the region of country within which the excessive and dangerous heat of the month was experienced, covers that portion of territory extending northward from the central portion of the Gulf to the Lakes, corresponding thereby, with the area of greatest departure of the monthly mean from the average for many years. Within the region above indicated the high temperatures of the month appeared to be productive of most suffering, in the Ohio valley. The period covering the occurrence of this marked rise in the temperature, is confined to that portion of the month included between the 5th and 15th, and again between the 19th and 22nd. In connection herewith, and with a view to elucidate, it is of interest to carefully consider chart No. I. for the month, on which is displayed the movement of the centres of areas of low barometer. The extreme northerly position of areas No. I, II and III, and their comparatively sluggish movement between the 80th and 100th meridians appeared to induce an excessive movement northward of the warm air from the Gulf, which added to the modifying intensity of local influences such as cloudiness, humidity and topography would form a powerful exponent in the production of high temperatures.

The following reports are from various sources, but independent of the data obtained from Signal Service stations: Cincinnati, for the week ending July 14th, the health officer reported 549 deaths, 213 of which were caused by actual sunstroke, 150 brought on by the influence of extreme heat, and the remainder the result of various diseases. The least number of deaths by sunstroke, (20) occurred on the 7th and the greatest 68, on the 11th. Charleston, S. C., 22nd, highest temperatures ever recorded in the history of the city occurred on this day, but accompanied by no sunstrokes. At Dr. Blackman's drug store the thermometer registered at 8 a. m. 90°; 10 a. m., 96°; 12, noon, 99.5°; 2 p. m., 104°; 4 p. m., 101°; 6 p. m., 97°; 8 p. m., 95°; average for the twelve hours 97.5°. At the State Quarantine office, 8 a. m., 89°; 1 p. m., 100°; 2.30 p. m., 102°; 3 p. m., 97°; average for the seven hours 97°. On the 12th of July, 1879, the temperature at Dr. Blackman's reached a maximum of 101°, the average for the day being 95.5°. In warehouses and under tinned sheds in various por-

tions of the city, higher temperatures were recorded. At that time the suffering from heat was very great, 15 deaths being recorded from sunstroke. A large number of horses were stricken down in the streets, and the street railways were compelled to suspend operations during most of the day. Although the hourly record as well as the daily average temperature is higher for July, 1881, still the effect of the heat upon persons and animals appears to have been far less disastrous. A strong southwest wind was blowing nearly all day, which very probably relieved the actual heat of the body bythe rapid evaporation of moisture from its surface. During the heated spell of July, 1879, there was a perfect calm for nearly two days. A careful research through all the accessible authorities on the subject of maximum temperatures in Charleston, shows that for 100 years previous to 1738 the thermometer had never reached 98°, and that for 114 years previous to 1752 it had never reached 101°, except in that year. From 1752 up to 1791, the highest point reached was 97°. This gives a clear record from 1638 up to 1791, showing that the highest point reached during that period was 101° in 1752. Franklin, Ohio, 11th, 108° in the shade, great suffering from the heat, but no sunstrokes. Covington, Ky., 11th, 7 fatal cases of sunstroke; 12th, 11 cases, 3 fatal. St. Louis, 11th, 38 cases of sunstroke since the 8th, 23 of which were fatal; 12th, 21 cases, 7 fatal. Lincoln, Ill., 21st, 100° in the shade, no sunstrokes. Decatur, Ia., 21st, 2 sunstrokes, 1 fatal. Springfield, Ill., 21st, several sunstrokes, none fatal. Louisville, Ky., 11th, 7 fatal cases of sunstroke; 12th, 2 fatal. Memphis, Tenn., 12th, 4 fatal cases of sunstroke. Pittsburg, 12th, 7 sunstrokes, 4 fatal. Lafayette, Ind., 12th, 6 fatal cases of sunstroke; hogs and cattle dying from excessive heat. Dayton, Ohio, 11th, 100 cases of sunstroke, 30 of which were fatal; 12th, 5 fatal cases. Shelbyville, Ind., 12th, a. m., 102°; 2 p. m., 106°, hottest for past 36 years; evening, 100°; three fatal sunstrokes. Kankakee, Ill., 12th, one fatal case of sunstroke; hottest weather for many years. Springfield, Ohio, 12th, 12 cases of sunstroke, two fatal. Wilmington, Ohio, 10th to 12th, temperature remained steady from 99° to 101°; hottest in past 40 years; two fatal cases of sunstroke. Portsmouth, Ohio, 12th, 104° to 108°; five cases of sunstroke, one fatal. Lima, Ohio, 12th, eight cases of sunstroke, none fatal; Piqua, Ohio, 12th, 100° in the shade; three cases of sunstroke, one fatal. Logan, Ohio, 12th, 103° in the shade; five cases of sunstroke, two fatal. Zanesville, Ohio, 11th, six cases of sunstroke, none fatal; 12th, five cases, none fatal. Ft. Wayne, Ind., 12th, two cases of sunstroke, one fatal. Rising Sun, Ind., 12th, 102° in the shade; two cases of sunstroke, none fatal. Waynesville, Ohio, 12th, one fatal sunstroke. Paris, Ky., 12th, one fatal sunstroke. Keokuk, Ia., 12th, 100° in the shade; one fatal

Table of Maximum and Minimum Temperatures for July, 1881.

State or Territory.	Signal Service.			U. S. Army Post Surgeons or Voluntary Observers.		
	Station.	Max.	Min.	Station.	Max.	Min.
Alabama	Mobile	101°	69°	Green Springs	103°	
Do				Auburn		66°
Arizona	Ft. Verde	114°		Texas Hill	117°	
Do	Prescott		51°			
Arkansas	Little Rock	100°	67°	Mt. Ida		50°
California	Visalia	104°		Mam'oth Tank	116°	
Do	Campo		33°			
Colorado	Denver	99°		Ft. Lyon	104°	
Do	Pike's Peak		30°			
Connecticut	New London	90°				
Do	New Haven		54°			
Dakota	Smithville	108°				
Do	Rapid City		37°			
Delaware	Breakwater	90°	60°			
Dist. Columbia	Washington	96°	62°			
Florida	Jacksonville	99°		Houston & Maypert	100°	
Do	Cedar Keys		69°	Ft. Barrancas		66°
Do						
Georgia	Augusta	102°	64°	Forsyth	106°	
Iowa	Des Moines	98°	56°	Ft. Madison &		
Do				Des Moines	100°	
Do				Nora Springs		50°
Idaho	Ft. Lapwai	104°	40°			
Illinois	Springfield	96°	57°	Swanwick	104°	
Do				Riley		54°
Indiana	Indianapolis	101°	57°	Logansport & Vevay	102°	
Do						
Do				Logansport		56°
Indian Ty	Fort Sill	106°				
Do	Fort Gibson		63°			
Kansas	Leavenworth	100°	60°	Clay Centre	109°	
Do				Yates Center		56°
Kentucky	Louisville	101°	62°			
Louisiana	Shreveport	103°	66°			
Maine	Portland	84°		Cornish	92°	
Do	Eastport		49°			
Maryland	Baltimore	96°	65°	Cumberl'd, Gwing'		
Do				Mill's & Emmitsb'g		60°
Massachusetts	Boston	89°	54°	Somerset	96°	
Do				Williamstown		48°
Michigan	Marquette	97°	45°	Thornville	99°	
Minnesota	Moorhead	95°				
Do	St. Vincent		40°			

State or Territory.	Signal Service.			U. S. Army Post Surgeons or Voluntary Observers.		
	Station.	Max.	Min.	Station.	Max.	Min.
Mississippi	Vicksburg	100°	62°			
Missouri	St. Louis	104°	62°	Pierce City		54°
Montana	Fort Keogh	106°				
Do	Ft. Assinab'ne		35°			
Nebraska	North Platte	104°	58°	Lincoln	109°	54°
Nevada	Winnemucca	97°	40°			
Do				Hot Springs Golconda, Palisade & Otego	105°	
Do				Carson City		38°
N. Hampshire	Mt. Washing'n	72°	32°	Auburn	98°	
New Jersey	Barnegat	92°		Ateo and Vineland	96°	
Do	Atlantic City		57°	Freehold		56°
New Mexico	La Messilla	105°		Fort Union		45°
Do	Santa Fé		53°			
New York	Rochester	96°	54°	West Point	97°	
Do	Oswego	96°		Johnstown		43°
North Carolina	Charlotte	100°		Weldon	102°	
Do	Smithville		61°	Highlands		52°
Ohio	Columbus	103°		College Hill	109°	
Do	Cincinnati	103°				
Do	Cleveland		56°			
Oregon	Roseburg	91°	42°			
Pennsylvania	Pittsburg	103°	57°	Milton	104°	
Do				Franklin		44°
Rhode Island	Newport	87°	57°	Fort Adams	91°	56°
South Carolina	Charleston	103°	67°	Stateburg		64°
Tennessee	Nashville	101°		Ashwood and		
Do	Knoxville		56°	Austin	102°	
Texas	Eagle Pass	112°				
Do	Fort Davis		53°			
Utah	Salt Lake City	96°	46°	Promontory	106°	
Do				Coalville		39°
Vermont	Burlington	90°	52°	Charlotte	99°	
Do				Woodstock		46°
Virginia	Norfolk	102°		Wytheville &		
Do	Cape Henry		60°	Snowville		50°
Washington Ty	Almota	103°				
Do	Colfax and					
	Dayton		37°			
West Virginia	Morgantown	89°	55°	Flemington	98°	
Do				Helvetia		49°
Wisconsin	La Crosse	98°		MissionHouse	97°	
Do	Milwaukee		55°	Neillsville		50°
Wyoming	Cheyenne	100°	45°	Ft. Bridger		32°

Table of Comparative Maximum Temperatures for the month of July.

State or Territory.	Maximum for July, 1881, Signal Service.		Highest since Signal Service Stations were opened—3 to 10 years.			Highest from any other source.			
	Station.	Temp.	Station.	Year.	Temp.	Place.	Year.	Temp	Length of Record.
Alabama	Mobile	101°	Montgomery	1877	103°	Huntsville	1875	101°	9 years.
						Wilsonville	1879	101°	8 "
Arizona	Fort Verde	114°	Yuma and Phœnix	1879	116°	Fort Mojave	1877	119°	4 "
Arkansas	Little Rock	100°	Little Rock	1879	100°	Washington	1869	108°	27 "
California	Visalia	104°	Visalia	'77,'79	107°	Fort Yuma	1877	119°	24 "
						Fort Miller	1853	119°	13 "
Colorado	Denver	99°	Denver	1874	102°	Fort Lyon	'68,'78	106°	13 "
Connecticut	New London	90°	New Haven	1876	95°	New Haven	1864	102°	87 "
Dakota	Smithville	108°	Fort Sully	1877	109°	Fort Sully	1871	114°	8 "
Delaware	Delaware Breakwater	90°	Delaware Breakwater	1880	91°	Fort Delaware	1865	101°	74 "
Dist. of Columbia	Washington	98°	Washington	1879	102°	Washington	1838	103°	48 "
Florida	Jacksonville	99°	Jacksonville	'75—'77	101°	Houston	1879	108°	8 "
						Fort Barrancas	1854	100°	52 "
Georgia	Augusta	101°	Augusta	1878	105°	Fort McPherson	1878	105°	5 "
						Augusta Arsenal	1845	103°	48 "
Iowa	Des Moines	98°	Dubuque	1874	101°	Brookside	1868	105°	5 "
						Fort Madison	1870	105°	20 "
Idaho	Boise City	101°	Boise City	1877	106°	Fort Boise	1871	113°	14 "
Illinois	Cairo and Springfield	99°	Springfield	1879	102°	Chicago	1868	100°	47 "
Indiana	Indianapolis	101°	Indianapolis	1874	97°	Wabash	1876	104°	7 "
Indian Territory	Fort Sill	106°	Fort Gibson	1879	109°	Fort Gibson	1834	106°	46 "
						Fort Sill	1879	106°	5 "
Kansas	Dodge City	104°	Dodge City	1876	108°	Fort Larned	1871	115°	14 "
						Fort Leavenworth	1860	105°	50 "
Kentucky	Louisville	101°	Louisville	1874	102°	Bennettsville	1876	98°	6 "
						Newport Barracks	1871?	98°	28 "
Louisiana	Shreveport	105°	Shreveport	1875	107°	Fort Jesup	1824	101°	22 "
						Baton Rouge Barracks	1877	102°	58 "
						New Orleans	1840	100°	61 "
Maine	Portland	84°	Portland	1876	97°	Brunswick	1808	108°	53 "
Maryland	Baltimore	96°	Baltimore	'79,'80	99°	Fort Washington	1853	102°	38 "
						Fort McHenry	1879	102°	42 "
Massachusetts	Boston and Springfield	89°	Boston	1880	101°	Fort Warren	1872	100°	12 "
						New Bedford	1818	96°	68 "
Michigan	Marquette	97°	Marquette and Detroit	1878	100°	Marquette	1862	103°	22 "
						Monroe	1866	103°	11 "
Minnesota	Moorhead	95°	Breckinridge	'73,'78	97°	Fort Ripley	1871	103°	20 "
						Fort Snelling	1838	100°	61 "
Mississippi	Vicksburg	100°	Vicksburg	1878	100°	Brookhaven	1879	102°	8 "
Missouri	St. Louis	104°	St. Louis	'74,'79	100°	Allenton	1868	109°	4 "
						Jefferson Barracks	1860	103°	36 "
Montana	Fort Keogh	106°	Fort Benton	1874	100°	Fort Shaw	1872	112°	13 "
			Fort Keogh	1879	100°				
Nebraska	North Platte	104°	North Platte	1877	107°	Fort McPherson	1870	115°	15 "
						Fort Kearney	1857	102°	20 "
Nevada	Winnemucca	97°	Winnemucca	1877	104°	Camp Halleck	1875	110°	13 "
New Hampshire	Mount Washington	72°	Mount Washington	1875	69°	Stratford	1868	100°	10 "
						Dunbarton	1880	100°	6 "
New Jersey	Barnegat & Atlantic City	92°	Sandy Hook	1876	100°	Fort Constitution	1850	96°	33 "
						Haddonfield	1866	102°	6 "
New Mexico	La Mesilla	105°	La Mesilla	1880	107°	Newark	1879	99°	35 "
						Fort McRae	1873	116°	10 "
New York	Oswego and Rochester	96°	Oswego	1878	100°	Fort Union	1871	101°	30 "
						Poughkeepsie	1849	105°	20 "
						Newburg	1849	105°	40 "
						Moriches	1868	103°	16 "
North Carolina	Charlotte	100°	Wilmington	1879	103°	Fort Columbus	1825	104°	59 "
						Weldon	1879	107°	8 "
Ohio	Columbus & Cincinnati	103°	Cincinnati	1874	103°	Fort Johnson	1831	102°	54 "
						Marietta	1859	102°	53 "
Oregon	Umatilla	106°	Umatilla	1880	107°	College Hill	'68,'79	99°	67 "
Pennsylvania	Pittsburg	103°	Pittsburg	'76,'78	101°	Fort Dalles	1853	105°	16 "
						Carlisle Barracks	1868	105°	34 "
Rhode Island	Newport	87°	Newport	1878	92°	Philadelphia	1866	101°	122 "
South Carolina	Charleston	103°	Charleston	1879	104°	Fort Adams	1867	102°	39 "
Tennessee	Nashville	101°	Nashville	'74,'79	107°	Charleston	1752	101°	243? "
						Castalian Springs	1875	103°	5 "
						Glenwood Cottage	1860	99°	10 "
Texas	Eagle Pass	112°	Laredo	1879	110°	Fort Mason	1860	114°	9 "
						San Antonio	1871	108°	34 "
Utah	Salt Lake City	96°	Salt Lake City	1877	98°	Mount Carmel	1877	112°	7 "
						Camp Douglas	1871	103°	19 "
Vermont	Burlington	90°	Burlington	1878	96°	Randolph	1868	102°	4 "
						Lunenburg	1864	97°	19 "
Virginia	Norfolk	102°	Norfolk	1876	103°	Nattaway	1876	111°	2 "
						Fortress Monroe	1837	102°	55 "
Washington T'y	Almota	103°	Dayton	1880	102°	Fort Walla Walla	1859	107°	10 "
						Fort Townshend	1870	95°	22 "
West Virginia	Morgantown	89°	Morgantown	1874	97°	Weston	1877	98°	3 "
Wisconsin	La Crosse	95°	La Crosse	1874	101°	Embarrass	1866	104°	17 "
						Fort Winnebago	1838	104°	14 "
						Fort Howard	1823	100°	30 "
						Fort Crawford	1839	100°	25 "
Wyoming	Cheyenne	100°	Cheyenne	1874	98°	Fort Laramie	1876	107°	27 "

sunstroke. Madison, Ohio, 12th, one fatal sunstroke. Somerset, Ohio, 12th, six cases of sunstroke, none fatal. Vincennes, Ind., 12th, one fatal sunstroke. Circleville, Ohio, 12th, seven cases of sunstroke, none fatal. Gore, Ohio, 12th, 106° in the shade, hottest ever known, all business suspended. New Albany, Ind., 12th, 102° to 104° from 11 a. m. to 4 p. m.; six cases of sunstroke, three fatal. Burlington, Ia., 12th, 100° in the shade. Muncie, Ind., 11th, 100° to

103° in the shade; six cases of sunstroke, one fatal. Thornton, Ind., 11th, 104° in the shade, highest ever known; no sunstrokes. Charleston, Ind., 11th, 103° in the shade; two cases of sunstroke, one fatal. Connersville, Ind., 11th, 104° in the shade; two cases of sunstroke. Alton, Ill., 11th, one fatal sunstroke. Sidney, Ohio, 11th, 103° in the shade; one fatal sunstroke. Madison, Ind., 11th, one fatal sunstroke. Columbus, Ind., 11th, one fatal sunstroke. Clinton, Ill., 12th, maximum temperature for past 10 days 102° to 108°; hottest ever known, all business suspended; no sunstrokes. Danville, Ill., 102° in the shade; 4 cases of sunstroke, all laborers suspended work; warmest in 15 years. New Castle, Ind., 12th, one fatal sunstroke. Bluffton, Ind., 12th, 104° in the shade; 10 cases of sunstroke, none fatal. Knightstown, Ind., 12th, two cases of sunstroke, none fatal. Peru, Ind., 12th, hottest for many years, no sunstrokes. Tuscola, Ind., 12th, 100° to 105° in the shade, several cases of sunstroke, none fatal. Indianapolis, 9th, 3 cases of sunstroke, 2 fatal; 10th, 104°, 8 cases of sunstroke, 3 fatal; 11th, 100° at 4 p. m., 8 cases of sunstroke, 4 fatal; 12th, 99°, 7 cases of sunstroke, 2 fatal. Southport, Ind., 12th, 1 fatal sunstroke. Wheeling, W. Va., 12th, 1 fatal sunstroke. Chicago, 8th, 12 sunstrokes, 4 fatal. Assumption, Ill., 8th, 1 fatal sunstroke. Paxton, Ill., 8th, 1 fatal sunstroke.

Frost.—Campo, Cal., 1st, light; Crows Nest, Mont., 17th, light, 18th, heavy; Fall River, Mass., 5th, heavy; Carson City, Nev., 3d, light; Coalville, Utah, 8th.

PRECIPITATION.

The general distribution of rain-fall for July, 1881, is shown on chart No. III, from the reports of over 500 stations. From the table in the left hand corner of the chart is obtained a monthly average for each of the various districts, determined from the records (covering a period of many years) of Signal Service stations, and also a comparison of the present month with such averages. Upon examination of the chart and a comparison with the records of July for previous years, it is found that there is a general deficiency over the country east of the 100th meridian, being most marked in Tennessee and the Ohio valley. Within this large area of unusual deficiency for the month, there is a small area of remarkable excess, 4.69 inches, covering the Upper Mississippi valley; there are small excesses in the South Atlantic states and in the Upper Lake and Northern Pacific Coast regions. Although no precipitation was reported during the month throughout California west of the Serria Nevadas, the condition is normal. Over the Plateau regions and at the Rocky Mountain stations the usual irregularity of distribution prevails. In southeastern Arizona and southern New Mexico an unusually heavy precipitation was recorded for the month.

Deviations from the Average Precipitation for Several Years.—Illinois: Anna, this July is the only month during the past 18 years, that has no record of rainfall. *Maine*: Gardiner, monthly rainfall 0.38 inch above the mean for past 45 years. *Missouri*: St. Louis, Missouri Weather Service reports: monthly rainfall, 1.70 inches below the normal. *New York*: North Volney, monthly rainfall, 1.18 inches below the mean for the past 13 years.

Special Heavy Rains.—1st, Wilmington, N. C., 4.48 inches; Smithville, N. C., 2.85; Elsworth, N. C., 2.25, in 1 hour and 15 minutes. 3rd, New Orleans, La., 3.11 in 1 hour and 15 minutes. 4th, San Gorgonio, Cal., 0.94, in 1 hour and 30 minutes. 6th, Elmira, Ill., 1.23, in 39 minutes. 6th and 7th, Ames, Ia., 4.70. Dubuque, Ia., 2.17, in 2 hours. 9th, El Paso, Tex., 6.50 in 2 hours. 9th and 10th, De Soto, Nebr., 2.80. 10th, Dubuque Ia., 3.32; Logan, Ia., 3.00; Ames, Ia., 4.55; Clear Creek, Nebr., 1.25, in 25 minutes. 11th, Ames, Ia., 5.35; Port Jervis, N.Y., 1.62, in 1 hour and 30 minutes; Elsworth, N. C., 2.00, in 1 hour; Patterson, N. J., 0.50, in 4 minutes. 12th, Ft. Scott, Kan., 3.80; Flemington, W. Va., 2.00, in 2 hours; Detroit, Mich., 2.23 in 1 hour. 13th, Carroll, O., 12.00, in 3 hours, (estimated.) 14th, College Hill, O., 2.50, in 4 hours. 19th, Port Eads, La., 2.96; Omaha, Nebr., 1.00, in 20 minutes. 20th, Mallory Lake, Hillsdale Co., Mich., 0.90, in 10 minutes; Niles, Mich., 3.08; Augusta, Ga., 1.28, in 1 hour and 5 minutes. 20th and 21st, Coldwater, Mich., 3.90. 21st, Madison, Wis., 4.32; Riley, Ill., 2.03, in 45 minutes; La Crosse, Wis., 5.00; Cresco, Ia., 2.18, in 1 hour; Langanore Mills, Bernon Co., Wis., 7.00, in 14 hours. 21st and 22nd, North Lewisburg, O., 4.50; Niles, Mich., 3.60, in 10 hours; Ft. Supply, Ind. Ty., 5.10. 22nd, Columbus, O., 2.24, in 9 hours; Elsworth, N. C., 1.25, in 2 hours and 30 minutes; Helvetia, W. Va., 2.91, in 10 hours; Memphis, Tenn., 0.81, in 20 minutes; Silver City, N. Mex., 2.03, in 1 hour. 24th, Guttenburg, Ia., 0.63, in 30 minutes; La Crosse, Wis., 0.75, in 8 minutes. 25th, Antrim, N. H., 4.33; Ashland, N. H., 3.60; Belmont, N. H., 3.08; Rowe, Mass., 3.00, in 12 hours; Auburn, Ala., 1.05, in 30 minutes. 25th and 26th, Grafton, N. H., 3.40; Lake Village, N. H., 2.89; Weir's Bridge, N. H., 3.74; Bristol, N. H., 4.29; Wolfboro, N. H., 3.00; Williamstown, Mass., 3.75. 26th, Tucson, Ariz., 3.00, in 6 hours and 44 minutes. 27th, Wilmington, N. C., 2.97; Smithville, N. C., 2.81; New Orleans, La., 1.13, in 42 minutes. 28th, Ft. Barrancas, Fla., 1.17, in 30 minutes. 30th, Denver, Colo., 1.10, in 20 minutes. 31st, Atco, N. J., 3.00, in 5 hours; Dyberry, Pa., 1.00, in 15 minutes.

Largest Monthly Rainfalls.—Ames, Ia., 16.31 inches; Wilmington, N. C., 12.40; Cedar Key, 11.86; Smithville, N. C., 10.65; Dubuque, 10.53; Port Eads, 10.44; Mt. Washington, 9.93; Macon,

N. C., 9.70; Silver City, N. M., 9.62; Logan, Ia., 9.50; Helvetia, W. Va., 9.48; Madison, 9.47; Fort Supply, Ind. Ty., 9.34; La Crosse, 8.86; Cape Henry, 8.57; Niles, Mich., 8.48; El Paso, 8.17; Auburn, N. H., 7.92; Rockford, Ill., 7.72; Flemington, W. Va., 7.60; Cresco, Ia., 7.59; Elsworth, N. C., 7.37; Hudson Mich., 7.14; Independence, Ia., 7.10; Johnsontown, Va., 7.00; New Orleans, 6.97; Coldwater, Mich., 6.75; Clear Creek, Neb., 6.58; Pikes Peak, 6.55; Norfolk, 6.47; St. Augustine, Fla., 6.38; De Soto, Neb., 6.35; Portsmouth, N. C., 6.33; Antrim, N. H., 6.2.; Fort Barrancas, Fla., 6.21; Beloit, Wis., 6.20; Hatteras, N. C., 6.16.

Smallest Monthly Rainfalls.—In California, throughout the San Joaquin and Sacramento valleys and westward to the ocean, the precipitation varied from 0.00 to 0.03 inch; south of Tulare Lake, along the line of the S. P. R. R., to the 115th meridian, no rain fell during the month, although no less than 18 stations reported regular observations. Over the Sierra Nevada Mountains, along line of the C. P. R. R., east of Sacramento to the Nevada state line, eight stations reported, at only one of which rain fell, viz: Truckee, 0.18 inch. Elsewhere, the smallest rainfalls are reported as follows—Elko, Nev., 0.01 inch; Corinne, Utah, and Ashwood, Tenn., 0.02; Texas Hill, Ariz., 0.03; Fort Concho, Tex., 0.04; Beowawee, Nev., 0.05; Reno, Nev., Fort Totten, D. T., and St. Meinrad, Ind., 0.10; New Harmony, Ind., 0.11; Laredo, Jacksboro, and Clarksville, Tex., 0.12; Boise City, 0.13; Cairo, Ill, 0.18; Yuma, Ariz., and Hot Springs, Nev., 0.20; Austin, Tenn., 0.20; Salt Lake City, Utah and Smithville, Dak., 0.21; Pioche, Nev., and Terry's Landing, Mont., 0.23; Terrace, Nev., 0.29; Port Angles, Wash. Ty., 0.30; Point Pleasant La., 0.31; Carson City and Otego, Nev., 0.34; Fort Scott, Kan., and Madison Bks., N. Y., 0.38; Fort Keogh, Mont., 0.39; Fort Pembina, Dak., and Fort Douglas, Utah, 0.40; McPherson Bks., La., 0.43; Greensboro, N. C., 0.45; Thornville, Mich., 0.47; and St. Vincent, Minn., 0.48.

Rainy Days.—The number varied in New England from 8 to 21; Middle Atlantic states, 7 to 15; South Atlantic states, 6 to 17; East Gulf states, 6 to 17; West Gulf states, 4 to 14; Ohio valley and Tennessee, 5 to 17; Lower Lake region, 8 to 12; Upper Lake region, 5 to 12; Upper Mississippi valley, 1 to 12; Missouri valley, 5 to 11; Red River of the North valley, 6 to 11; Texas, 1 to 12; Rocky Mountains, 5 to 16; Middle Plateau, 0 to 10; Southern Plateau, 2 to 20; California, 0 to 4; North Pacific coast region, 8 to 13.

Cloudy Days.—The number varied in New England from 3 to 11; Middle Atlantic states, 3 to 10; South Atlantic states, 2 to 12; East Gulf states, 1 to 7; West Gulf states, 1 to 7; Ohio valley and Tennessee, 0 to 4; Lower Lake region, 2 to 5; Upper Lake region, 2 to 7; Upper Mississippi valley, 0 to 7; Missouri valley, 1 to 8; Red River of the North valley, 3 to 7, Texas, 0 to 6; Rocky Mountains, 2 to 10; Middle Plateau, 0 to 7; Southern Plateau, 0 to 12; California, 0 to 6; North Pacific coast region, 6 to 11.

Snow.—Missoula, Mont., 31st, snow was clearly seen on several of the highest peaks in the main range of Bitter Root Mountains, among the most prominent being Lo Lo. Dayton, Wash. Ty., 6th, light snow fell on mountains 10 miles to the southeast.

Rain from a Cloudless Sky.—Wooster, Ohio, 30th, at 9 p. m.

Hailstorms were of frequent occurrence in the various districts, the most destructive being reported as follows: Lawrence, Mass., 4th, 2.40 p. m., most violent ever known here; for about ten minutes hail-stones fell the size of English walnuts; damage to private residences, mills, green-houses and work shops, is estimated at thousands of dollars; fruit trees terribly injured. South Framingham, Mass., 4th, heaviest for many years; great damage to crops and window glass; one florist lost 800 panes from his green-house. Tewksbury, Mass., 4th, very destructive; crops and fruit trees badly damaged; in one hot-house 3,000 panes of glass broken; windows at the State Asylum damaged to the amount of several hundred dollars. Lynn, Mass., 4th, 12.40 p. m., hail-stones, size of cherries, largest ever seen here before; much damage to vegetable and farm crops. Flemington, W. Va., 16th, three miles north of station a strip of ground half a mile wide and six miles long was badly damaged by hail, which lay in heaps upon the earth; fruit trees stripped of foliage, tobacco and corn destroyed, and other crops more or less damaged. Brockton, Mass., 21st, hail-stones varied from half an inch to one and a half inches in diameter; damage to window glass very severe; all the large factories suffered heavy loss; reports from surrounding agricultural towns indicate an immense amount of damage. Phillips, Me., 21st, hail-stones of all sizes and shapes, square, long, round, and varying in size from walnuts to near a man's fist; great damage to crops and buildings. Abington, Mass., 21st, hail-stones size of large hickory nuts; considerable damage to crops. Winona, Wis., 11th, hail-stones size of hen's eggs, trees stripped of foliage, and large quantities of window glass broken. Cumberland Co., Me., 26th, 5.30 p. m., passed from SW. to NE. through the townships of Falmouth, Cumberland and Yarmouth, for a distance of about 20 miles; width of path from one and a half to two miles. The central part of the storm belt was the most destructive, and within the limit of a quarter of a mile every crop was literally cut to pieces. Whole fields of grass were buried beneath the tremendous fall of hail, orchards were completely stripped of foliage and small limbs, and, in some instances, trees 18 inches in diameter were broken off "like pipe stems." Every house in the line of the storm had its windows completely riddled. The hail-stones varied in size from large

marbles to hen's eggs, and fell in such quantities that, at some points of the storm path, on the following morning, they were gathered to the depth of two feet, and again, even as late as noon, some portions of the wagon roads were covered with a "perfect bedding of hail-stones." The loss to the farming community is estimated at $30,000. No such storm has ever visited this section since 1833, when the hail was about as large, and the path identical. Hadley, Me., 21st, most violent and destructive storm within the memory of the oldest inhabitant; all glass on the north sides of buildings, where not protected, was broken; Tobacco and corn crops a total loss; trees were stripped of their foliage, and, in some instances, those having a diameter of about one foot, were twisted or broken off; dead birds were found under almost every tree. Sparta, Ky., 21st, hail-stones size of hen's eggs, causing great damage to fruit and corn. St. John, N. B., 21st, great damage to crops in parts of Kent county, particularly in the parishes of Richibucto and Welford. Hadlyme, Conn., 21st, most violent since July 28th, 1838, when half the windows in the town were destroyed, and much other damage done. Hail-stones size of large walnuts; the damage to farming industries will reach many thousand dollars.

RELATIVE HUMIDITY.

The percentage of mean relative humidity for the month ranges as follows: New England, from 68 to 90; Middle Atlantic states, 56 to 81; South Atlantic states, 53 to 82; East Gulf states, 68 to 76; West Gulf states 56 to 77; Ohio valley and Tennessee, 58 to 76; Lower Lake region, 64 to 72; Upper Lake region, 63 to 74; Upper Mississippi valley, 61 to 75; Missouri valley, 64 to 74; Red River of the North valley, 59 to 73; Texas, 52 to 62; Middle Plateau, 30 to 42; Southern Plateau, 43 to 61; California, 33 to 77; Oregon, 46 to 64; Washington Territory, (Olympia,) 71. *High stations* report the following percentages not corrected for altitudes: Pike's Peak, 69.0; Santa Fé, 55.0; Cheyenne, 55.8; Denver, 47.6; Mt. Washington, 81.8,

WINDS.

The prevailing winds during the month of July, 1881, at Signal Service stations, are shown on chart No. II by arrows, which fly with the wind. Between the 82d and 92d meridians, *westerly*. Along the South Atlantic coast, *southeast*, and on the Middle Atlantic and New England coasts, *southwest* to *northwest*. In the Western Gulf states and Missouri valley, *east* and *south*. Over Texas and the eastern Rocky Mountain slope, *south* and *southeast*. In the Plateau regions, *southerly*, and along the Pacific coast, *westerly*.

Total Movements of the Air.—The following are the largest total movements at the Signal Service stations: Mt. Washington, 14,442; North Platte, 11,319; Hatteras, 10,543; Portsmouth, N. C., 10,175; Moorhead, 9,657; Chincoteague, 9,434; San Francisco, 9,384; Kittyhawk, 9,082; Ft. Sill, 8,904. The *smallest* are: La Mesilla, 1,406; Silver City, 1,910; Phœnix, 1,989; Memphis, 2,063; Florence, 2,351; Lynchburg, 2 526; Uvalde, 2,596; Springfield, Mass., 2,641; Roseburg, 2,688; Lewiston, 2,709; Nashville, 2,721; Augusta, 2,728; Fredericksburg, 2,837; San Antonio, 2,850; Morgantown, 2,855; Tucson, 2,861.

High Winds.—Winds of 50 miles per hour and over were reported as follows: On summit of Mt. Washington, 13th, 14th, 16th; maximum velocity, 60 miles, NW., 13th. On summit of Pike's Peak no high winds were reported during the month, the maximum, 40, SW., occured on the 10th. Sandusky, 56, NW.,12th. Cape May, 60, SW., 14th. Kittyhawk, 60, N., 7th.

Local Storms.—Few storms of this character have occurred during the month, at least those particularly destructive, and, except the violent tornado at New Ulm, Minn., none accompanied with any unusual demonstration of force or attended with great loss of life and property have been reported. On the afternoon of the 15th, the terrible tornado which visited portions of southern Minnesota, appeared first as a violent northwest storm over the western portion of the state and eastern Dakota, in the vicinity of Big Stone and Traverse Lakes. With increasing energy the storm traveled southeasterly down the valley of the Minnesota river, desolating portions of the following counties: Big Stone, Lac Qui Parle, Swift, Chippewa, Renville, Sibley, Brown, Nicollet and Blue Earth. The general atmospheric conditions preceding and accompanying the formation of this storm, are given as follows: Since the 10th there had prevailed, with remarkable persistance, an area of comparatively low pressure over the western portions of Iowa and Minnesota, and the eastern portions of Nebraska and Dakota. There was considerable variability in the barometric readings within the area of low during this period, ranging, as they did, from 29.65 to 29.96. At midnight of the 10th, the winds, throughout the four states above mentioned, were from N. to E., with temperatures ranging from 57° to 74°. On the following morning, with the advent from Saskatchewan valley of an area of low pressure, the barometer fell from 0.03 to 0.18 inch below the normal, followed over Iowa and Nebraska by a veering of winds to the SE., occasional light rains and slowly rising temperature. Eliminating the element of diurnal change, there was noted the steady advance northward of a high thermal belt, coupled with the significant constancy of southerly winds south of parallel 45° and of W. to NW. winds to the northward as far as Manitoba. These conditions continuing unabated, there appeared on the afternoon of the 15th

a belt of high temperatures, ranging from 90° to 100°, extending from eastern Iowa westward to eastern Wyoming and Colorado. Over northern Minnesota and Dakota the temperature ranged from 70° to 85° with W. to NW. winds, presenting, in the extreme, a thermal range of 30° between the opposing northerly and southerly movements of the atmosphere. Here was abundant evidence of a very powerful concomitant in the event of sudden and violent displacements of atmospheric equilibrium. Throughout western Dakota on the 15th, thunder-storms occurred at at various points and with considerable severity. Returning to the supposed region of commencement, we find the first evidence of destructive force manifested at the town of Odessa, on the Hastings and Dakota Railroad, where four buildings were demolished. Passing thence southeastward the storm swept the sparsely settled country for a width of from one to two miles, destroying farm houses, barns, farm machinery and killing horses, hogs and cattle. At the town of Fairfield, Mayer township, Swift county, nearly every building was blown to pieces, four persons killed and fifteen wounded. Outside of the town farm houses, in the track of the storm, were destroyed to the number of nine, their contents and the broken timbers were scattered over the ground for hundreds of yards. The bridge over the Pomme de Terre river was lifted from its foundation, turned over and carried four rods down the river. At Bird Island, Renville county, several houses were blown down and others unroofed, but no lives lost; the most violent portion of the storm lay further to the southwest. At Cairo, the storm was more violent; one building was lifted bodily into the air and blown to pieces; great damage was done to other buildings; five persons badly injured. In the town of Wellington, three persons were killed and several wounded; six buildings destroyed; hogs, horses and cattle killed, several animals having pieces of timber driven through their bodies by the force of the wind; one piece of scantling was found driven into the ground a distance of four feet. At West Newton five persons were killed and twelve wounded; fifteen buildings were either demolished or unroofed; a piece of 40 acres of timber was nearly leveled with the ground; hardly a single tree was to be found in an upright position. At Severance, in the southwest part of Sibley county the destruction in town and surrounding country was very great. At Milford, in the northwestern portion of Brown county, twelve or fifteen buildings were destroyed and six persons badly injured. We now reach the town of New Ulm where the storm culminated its energy and the violence of its destructive power. The day had been exceedingly oppressive with a gentle southesterly breeze, and at 3.30 P. M. a heavy thunder-storm appeared in the northwest, followed in about 20 minutes by the sudden rising in the southwest of a dark and portentous cloud. These two clouds advanced towards each other, their line of march intersecting at what appeared to be a point about three miles west of the town. Before the meeting the first strong wind came from the northeast, which continued about ten minutes, during which it rained considerably. At the meeting there appeared to be a terrific contest as to which cloud should have the right of way, and when this seemed to be fully decided the clouds apparently came to the ground, the lower portion having a tendency to elongate and form a spout-like protuberance. Shortly after this action, there appeared to persons observing the phenomenon at some distance from the storm centre, the formation of four large spouts running downward to the earth; sometimes they touched it and again would be drawn suddenly upward to the sky. These spouts were reported as of various shapes: one in the form of an immense inverted cone; another cylindrical; a third like a huge gourd, and another oblong with convoluted edges. They moved along with a swiftly revolving motion from right to left, and their path of destruction was about a mile and a half wide. At 4.45 p. m., (some give it 4.40 and 4.48 p. m.,) the tornado entered the town where it remained but 10 or 12 minutes, during which time 47 buildings were blown to atoms, and about 200 either unroofed or otherwise demolished; 6 persons were killed, 53 wounded, and 102 families rendered homeless. The loss to property in the town alone is variously estimated at from $300,000 to $500,000. The general direction of the *debris* as carried by the wind, particularly in the case of trees, appeared to be to the northeast and northwest, although there were many instances where they pointed to the south and southeast. The boundary lines of destruction were very closely defined, small frame buildings standing near solid brick structures were unharmed, while the latter were leveled to the ground. Several persons variously estimated the velocity of the wind at from 90 to 115 miles per hour. As the storm left New Ulm and passed to the southeastward, it visited the country in the vicinity of Butternut Valley and Cottonwood Creek, where several building were unroofed and considerable stock killed. At 6 p. m., the storm passed over Blue Earth county, about eight miles north of Winnebago City and disappeared at a point about two miles to the northeastward. For a distance of about ten miles, the destruction to crops and buildings, and the loss of stock was very severe, but the storms path had narrowed considerably at this portion of its course, being now from a quarter to a half mile in width, with considerably diminished energy. Boys Lake, Redwood Co., Minn., 16th, a small tornado with funnel-shaped cloud destroyed a farm house, stable and small outbuildings, leaving hardly a vestige of them near their foundations. A small pond in the track of the cloud was sucked dry, the water being carried over the adjoining fields, together with a large quantity of soft mud which was scattered over the ground for half a mile around. Mulligan, Cottonwood Co., Minn., 16th, during the afternoon a violent wind storm passed over this section destroying nearly every movable object in its course; several buildings were blown to pieces and

others unroofed; the damage to crops was very severe. Farther eastward the storm was reported as exceedingly violent. Mallory Lake, Hillsdale Co., Mich., 12th, 3.30 p. m., two and a half miles southeast of station, violent southwest storm unroofing and destroying buildings, leveling fields of oats and corn, demolishing fences and uprooting forest and fruit trees; occasional gaps intervened, where the force of the wind seemed to raise for a short distance above the earth, and then return to it with renewed destructive energy. At Dover, fences were blown down, wheat shocks scattered over the fields and oats and corn badly damaged. Near Osseo several farm buildings were blown down, fences demolished and trees uprooted: in Wheatland and Palmyra townships much damage to crops. Brooklyn, N. Y., 13th, 4 to 4.25 p. m., trees, chimneys and small outbuildings blown down, and in several cases large buildings unroofed; in northern New Jersey and on Staten Island, the violence of the wind was very marked, trees were uprooted and many buildings blown down or unroofed. Cornish, Me., 16th, 4.30 p. m., violent wind storm or whirlwind passing from SW. to NE., moved over the adjoining country; width of path, about 50 rods and length about five miles; one large building, 70 x 15 feet, directly in the path of the storm-cloud was blown to pieces, carrying the *debris* several hundred yards; many other buildings were more or less damaged and orchards suffered severely; in passing over a cemetery, which chanced to be in the storm's path three large stones, 20 inches in diameter and several feet in height were broken off by the violence of the wind; some hail accompanied the storm, but did no damage; the storm-cloud, after crossing the Ossipee river, appeared to rise from the earth, when further evidence of its existence vanished. Fosteria, Ohio, 7th, during night, most violent windstorm for years; many buildings, among the largest in town, were unroofed and several blown down; in the country very disastrous effects were produced upon standing crops. Off Reedy Island, near Ft. Delaware, Delaware river, 7th, 7 p. m., terrific wind storm, lasting about 40 minutes; storm passed from SW. to NE. and the rain fell in torrents for about ten minutes; British bark "Beatrice" was struck by lightning and burned to the water's edge; the captain of an ocean steamer who passed through the storm stated that it was the most terrible he had witnessed in 20 years; it was short but exceedingly furious. Perry Valley, Iowa, 7th, violent wind storm passed over this region destroying several farm houses and the highway bridge over Perry's Creek. Rensselaer county, N. Y., 26th, violent wind storm swept over the county in the vicinity of Troy, demolishing buildings, uprooting trees and severely damaging crops. Ft. Supply, Ind. Ty., 22nd, 10.30 p. m., wind blew from the northwest at the rate of 30 to 60 miles per hour; but little damage was committed, owing to the sheltered position of the town. In northern Kentucky, southern Ohio and Indiana, violent wind and rain storms, causing great damage to crops and buildings were experienced on the 21st. Americus, Ga., 18th, at some distance from the town a small whirlwind, about 5 feet in diameter and sometimes 100 feet high, formed over a corn-field where it tore up the stalks by the roots and carried them with sand and other loose materials high into the air. The body of the whirling mass was of vaporous formation and perfectly black, the centre apparently illuminated by fire and emitting a strange "sulphurous vapor" that could be distinguished a distance of about 300 yards, burning and sickening all who approached close enough to breath it. Occasionally the cloud would divide into three minor ones, and as they came together again there would be a loud crash, accompanied by cracking sounds, when the whole mass would shoot upwards into the heavens. New Jefferson, Harrison, Co., Ohio, 16th, one church, many barns, stables and other buildings were blown down; about 20 horses were killed by the falling of stables; much damage to crops and fences in surrounding country. Atlanta, Ga., 12th, 5 p. m., terrific wind storm from the northwest, continuing for 30 minutes; the heavens were of inky blackness, which with the fury of the wind, made an appalling sight; coniderable damage was done to fences, trees and outbuildings. Winona, Wis., 11th, 5 p. m., the car shops of the Winona and St. Peter railroad, 40x150 feet, were completely demolished; the air was filled with boards and other *debris* during the passage of the storm; several other buildings were badly damaged. Ft. Wayne, Ind., 12th, 5 p. m., unroofing houses, destroying shade trees and fences and severely damaging crops. Danville, Va., 8th, 5 p. m., buildings unroofed and blown down and considerable destruction to fences, trees and crops. Dallas, Tex., 1st, during night, fearful storm of wind and rain, fences, outbuildings, six residences and one church were demolished.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily indications for July, 1881, with the telegraphic reports for the succeeding twenty-four hours, shows the general average percentage to be 87.57 per cent. The percentages for the four elements are: Weather, 93.6; Direction of the Wind, 83.1; Temperature, 87.3; Barometer, 86.3. By geographical districts they are: For New England, 86.9; Middle states, 82.6; South Atlantic states, 87.9; Eastern Gulf states, 91.4; Western Gulf states, 92.2; Lower Lake region, 86.0; Upper Lake region, 86.6; Tennessee and the Ohio valley, 90.8; Upper Missouri valley, 86.1; Lower Missouri valley, 84.3; Northern Pacific coast region, 98.3; Central Pacific coast region, 100.0; Southern Pacific coast region, 100.0. There were 82 omissions to predict (46 being due to the absence of reports from the Pacific coast), out of 3,813, or 2.15 per cent. Of the 3,731 predictions that have been made, 84, or 2.26 per cent are considered to have entirely failed; 140, or 3.75 per cent. were one-fourth verified; 376, or 10.07

per cent, were one-half verified; 347, or 9.30 per cent. were three-fourths verified; 2.784, or 74.62 per cent. were fully verified, so far as can be ascertained from the tri-daily reports.

Cautionary Signals.—Thirty-five Cautionary signals were displayed during the month, of which 29, or 82.86 per cent., were fully justified by winds of twenty-five miles per hour or over, at or within a radius of 100 miles of the station. No Off-shore signals were displayed. The above does not include signals ordered at display stations where the velocity is only estimated; one hundred and three winds of twenty-five miles or over were reported, for which no signals were ordered. Six signals were ordered late.

NAVIGATION.

Stage of Water in Rivers.—In the table on the right hand side of chart No. III are given the highest and lowest stages of water, as observed at Signal Service river guages during the month of July, 1881. At no time during the month were rivers above the danger line at any of the various stations. The highest water in the Red, Arkansas and Mississippi rivers was reached between the 3d and 4th; in the Mississippi river between the 1st and 18th; in the Ohio, Cumberland and Tennessee rivers between the 1st and 6th; in the Monongahela on the 23d and 24th, and in the Williamette, at Portland, Oregon, on the 1st.

Floods due to unusually heavy rains were particularly destructive to crops and other property in the northern portion of the Upper Mississippi valley, being most severe in those portions of the states of Illinois, Iowa, Wisconsin and Minnesota bordering the Mississippi river. *California.*—San Gorgoino, 4th, heaviest rain storm in 7 years; mountain streams turned into rushing torrents, washing out field crops and fruit trees. *Colorado.*—Denver, 30th, very heavy rains, flooding all streams and causing damage estimated at $50,000 to streets, stores and cellars. *Iowa.*—Carroll, Carroll Co., 13th, heaviest rain storm ever known in this state; 12 inches (estimated) fell in three hours; creeks and rivers overflowed and all bridges for miles were carried away, roads impassable and all communication cut off. Cedar Rapids, 13th, the destruction of railroad, farm and city property immediately west of here by heavy rains is unparalleled in the history of this region. The railroad companies were the greatest sufferers, a very large number of valuable bridges and culverts being washed out and many miles of track ruined. Marengo, 13th, river highest ever known; public square two feet under water and boats were propelled through the streets without difficulty; several large flouring and woolen mills flooded; court-house, post-office and a large number of business houses flooded; entire damage estimated at $500,000. Waukee, 11th, heavy washout on the Des Moines and Northwestern R. R. Leighton, 11th, between this station and Pella, track badly damaged and bridge carried away. Marshalltown, 11th, water four feet deep in the town, great damage to property. Colfax, 11th, water rose above the flat cars standing near the depot; tracks badly washed; communication cut off. Kellogg, 11th, from this town to Wilton railroad track badly washed; farming lands submerged; Raccoon and Des Moines rivers rising rapidly, cutting the levees badly. Bentonsport, 15th, Des Moines river, 12½ feet above low water mark, a rise of 32 inches in about twelve hours. Ottumwa, 15th, Des Moines river highest for years. Brighton, 15th, Skunk river overflowed; railroad bridge badly damaged. Des Moines, 11th, river at flood tide; several hundred yards of railroad track washed away; 15th, water much higher, inundating the first story of the flouring mill; the brick and saw mills completely surrounded; lower portion of city near Walnut street submerged; people deserted their homes; several narrow escapes; Raccoon river overflowed, backing up the Des Moines river, so as to submerge the western portion of city to the depth of four feet; lowlands to the southwest of city submerged, driving out the stock. Keokuk, 13th, Des Moines River, very high, damaging railroad bridge, 3 miles below station; 15th, river rose at the rate of 1½ inches per hour; 16th, full of heavy driftwood, track of the Keokuk and St. Louis R. R. submerged; 18th, river stationary at 22 inches above the danger-line; bottom lands below Alexandria overflowed and trains on the Keokuk and St. Louis R. R. stopped; 19th, river falling slowly. *Wisconsin.*—Salem, 21st, the La Crosse division of the Milwaukee and St. Paul Railroad badly washed in many places, delaying all trains. La Crosse, 21st, immense damage in surrounding country; all rivers and creeks above their banks; in the city, basements were flooded, in many cases entailing great loss; streets were very badly washed, in some cases to the depth of 12 or 15 feet Chaseburg, Vernon Co. 21st, water four feet higher than ever known before; great amount of damage done to buildings, bridges and crops. Coon Valley, 21st, water highest ever known; seven persons drowned; bridges all gone, roads impassable and all communication cut off. Winona Junction, 21st, 700 feet of the Chicago, Milwaukee and St. Paul Railroad washed out; heaviest rain storm for years. Campbell, 21st, bridges washed away; roads almost impassable. Bostick Valley, Vernon Co., 21st, bridges and dams entirely gone; over 500 tons of hay carried away by the rushing torrent of water; loss to farmers exceedingly severe in several instances reaching $1000 to a single proprietor. In the townships of Webster, Liberty and Kickapoo, nearly every bridge was swept away; at Bloomingdale and Avalanche the bridges, although

very substantial structures, could not withstand the terrible force of the flood. Reports from Springville, Vernon Co., show that the crops are completely ruined, and on the lowlands everything is several feet under water. At Kickapoo Centre and Readstown, highest water ever known; crops in a terrible condition. *Indiana.*—Ft. Wayne, 21st, heaveist rain storm for years; 35 feet of canal bank washed out in eastern part of city, and great damage done by the overflow of water. Between this city and Aboite aqueduct, five miles west, five breaks were reported; dangerous washouts on the Ft. Wayne and Jackson Railroad and on the Wabash Railroad; several new buildings in process of construction badly damaged. Goshen, 21st, all trains on the Air-Line Division of Lake Shore Railroad delayed on account of heavy washouts; heaviest rain storm for many years. New Paris, 21st, railroad tracks washed out; much damage to farm crops. Elkhart, 21st, all streams overflowed; heavy washouts on highways and railroad tracks. *New Mexico.*—Silver City, 22nd; in consequence of heavy rains, mountain streams were greatly swollen, flooding some of the principal streets to a depth of two feet; 25th, mountain streams again over flowed; 28th, streams again overflowed, badly washing streets and destroying considerable property. *New York.*—Dresden, 21st, heavy washout on the Delaware and Hudson Railroad, one passenger train wrecked. *Illinois.*—Waukegan, 21st, severest rain storm for years; roads impassable; fields flooded. *Michigan.*—Coldwater, 21st, terrible storm of wind and rain; hundreds of acres inundated in various parts of the county; large amount of hay and wheat ruined.

Drought.—*Alabama*, Selma, 15th, gardens and farm crops drying up. Montgomery, 15th, on several plantations in the surrounding country, the entire corn crop has been cut down to save the fodder, as the protracted drought has prevented it from developing. *Arkansas.*—In the northern part of the state no rain fell during the first half of the month; early corn badly damaged, other crops not seriously. *Illinois.*—Anna, 15th, crops suffering, wells, cisterns, ponds and creeks drying up. In the northern portion of the state, and especially in the oat section about Galena, drought has been very severe; the oat crop is a failure, and wheat will make about half a crop. Cairo, 15th, ground parched and vegetation drying up. Springfield, 15th, crops suffering. *Indiana.*—Vevay, 28th, crops and orchards suffering for want of rain; St. Meinrad, 16th, corn crop suffering. *Indian Territory.*—Cantonment, 11th, vegetables and field crops ruined; Ft. Gibson, crops suffering severely. *Georgia.*—In many localities in the interior and northern portions of the state, the corn crop is entirely lost, and garden crops have suffered severely. *Kansas.*—Independence, 30th, very dry, crops suffering; Clay Center, 28th, crops suffering. *Louisiana.*—Assumption Parish, 15th, corn and rice crops suffering severely; Calcasieu Parish, 15th, all crops suffering from want of rain, corn, cane and cotton, badly damaged; Catahoula Parish, 15th, corn and cotton suffering severely, the weather has been so hot, that, to a considerable degree, regular farm labor has been suspended; East Carroll Parish, 15th, corn crop greatly injured, cotton will harvest but half a crop; Lafayette Parish, 15th, corn and potatoes badly damaged and peas will harvest but half a crop; Ouachita Parish, 15th, corn will not harvest one fourth of the crop, and fodder is nearly all burned up; In Lafourche, Lincoln Rapides, and St. John Parishes, 15th, the corn crop has suffered severely and vegetables are badly damaged. *Missouri*—The Missouri State Weather Service reports: that the whole state has suffered from severe drought during the month; in the eastern and southeastern part of the state wells and creeks have dried up and vegetation has suffered severely; the ground was parched and dusty and the corn crop has been damaged to such an extent, not only in this section, but throughout the state, that hardly one-half of the usual crop will be harvested. Oregon, 30th, very dry, crops suffering. *Michigan.*—Litchfield, first part of month very dry, crops severely injured: Thornville, 15th, very dry; Port Huron, 17th, crops suffering severely. *Mississippi.*—In the central portion of the state corn and oats have suffered severely, and cotton has been more or less damaged in several counties. *North Carolina.*—Highlands, month very dry, crops suffering. *Ohio.*—Bethel, month very dry, crops suffering, fruit very poor; College Hill, month very dry, vegetation suffering; North Lewisburg, 1st to 20th, greatest drought ever experienced in this section. *Nebraska.*—Howard, very dry, crops suffering. *Pennsylvania.*—Milton, during former part of month, drought very severe, injuring crops badly. *South Carolina.*—Darlington, throughout the neighboring country, crops suffered during the first half of month. Barnwell Co., 30th, the winds for the past two weeks have been very hot and dry and the corn crop is a complete failure; Clarenden Co., corn will average about half a crop, and cotton about three-fourths of a crop. Williams Co., 30th, drought still prevailing, and is unprecedented in the annals of this county. Orangeburg Co., corn falling down in fields, compelling the farmers to harvest it as forage; driest weather for many years. Anderson Co., in the southern portion, crops literally ruined, the upland corn is dead, and cotton has shed nearly all of the little fruit it had. Marion, Co., 30th, corn will average from one fourth to half a crop. Sumter Co., 30th, corn and cotton crops badly damaged. *Tennessee.*—Ashwood, 30th, no rain for 33 days; Nashville, 30th, most severe ever known, far more destructive than the great drought of 1854; corn crop a complete failure. In some parts of western Tennessee, no rain has fallen since the last three day of June; cotton crop suffering greatly, farmers cutting down corn to save it for fodder; wells and streams dry, and people as well as animals are really suffering; in some cases, people are hauling drinking water a distance of several miles. The earth is baked, and roadways are powdered to a depth of 6 inches. Chattanooga, 30th, crops suffering severely. Memphis, 30th, crops suffering severely.

Texas.—Clarksville, 30th, crops suffering badly. In the counties of Atascosa, Arkansas, Bexar, Comanche, Fannin, Sabine, Hopkins, Henderson and Hunt, during the first part of month, crops suffered severely. Corsicana, 30th, month very dry, vegetation badly damaged Indianola, 7th, cisterns empty, streams very low. *Virginia.*—Wytheville, 30th, cisterns and streams drying up, crops suffering. Lynchburg, 12th, small streams completely dried up, and even wells fail to meet their purpose; cattle have to be driven, in some instances, as far as 6 miles for water, crops suffering badly.

Waterspouts.—Somerset, Mass., 21st, 3.15 p. m., two waterspouts observed on Taunton river. Lake George, Fla., 14th, two heavy squalls from opposite directions, met squarely in the lake in front of the observer's place, producing a terrible whirl, the water immediately rising from the centre of the whirl, forming a long column, reaching from the clouds to the lake, and having the form of an hour-glass. It traveled some distance and as the whirl subsided, broke in two in the middle, the upper part ascending and mingling with the clouds, and the lower part falling into the lake with a splash.

TEMPERATURE OF WATER.

The Temperature of Water, as observed in rivers and harbors at Signal Service stations, with the average depth at which observations were taken, is given in the table on the left-hand side of chart No. III. Daily observations for the entire month were made at all stations, except at Escanaba, where they are wanting from the 5th to the 11th, inclusive.

ATMOSPHERIC ELECTRICITY.

Thunder Storms.—In the various districts they were reported on the following dates: New England, 1st to 4th, 5th, 10th to 18th, 20th, 21st, 23rd to 29th. Middle Atlantic states, 1st, 3rd, 4th to 7th, 11th to 14th, 16th, 19th to 23rd, 25th, 26th to 31st. South Atlantic states, 1st, 2nd, 8th to 15th, 17th to 23rd, 25th to 28th, 30th 31st. Florida, 1st to 3rd, 10th to 24th, 27th to 31st. Eastern Gulf states, 1st, 2nd, 9th to 14th, 17th, 18th, 23rd, 25th to 28th. Western Gulf states, (including Texas) 1st, 2nd, 3rd, 4th, 6th 9th, 10th, 12th to 18th, 21st, 22nd, 24th, 25th, 29th. Ohio valley and Tennessee, 6th to 17th, 21st, 22nd, 25th, 27th to 30th. Lower Lake region, 5th, 6th, 7th, 8th, 10th, 12th, 13th, 16th, 18th, 20th, 21st, 25th, 27th, 29th to 31st. Upper Lake region, 4th to 10th, 12th, 13th, 15th, 16th 20th to 25th. Upper Mississippi valley, 2nd, 6th to 17th, 20th, 21st, 24th. Lower Missouri valley, 6th to 17th, 19th, 20th, 22nd to 25th, 29th. Southern Slope, 1st, 2nd, 8th, 10th, 11th, 14th to 17th, 19th, 24th to 31st. Middle Slope, 2nd, 4th, 5th, 6th, 8th, 10th, 12th, 13th, 20th, 21st, 22nd, 25th, 29th. Northern Slope, 1st, 2nd, 9th, 11th, 13th, 14th, 16th to 20th, 23rd, 25th, 30th. Southern Plateau, 3rd to 8th, 10th, 11th, 14th, 16th to 26th, 27th, 30th. Middle Plateau, 1st, 2nd, 10th, 15th to 19th, 25th, 27th, Northern Plateau, 2nd, 3rd, 9th, 11th 15th, 18th, 19th, 23rd, 24th, 26th to 28th. Southern Pacific coast region, 3rd, 25th. Middle Pacific coast region, 4th. Northern Pacific coast region, 18th, 23rd, 30th, 31st.

The following items of interest connected with the peculiar manifestations of electricity during the progress of thunder storms were obtained from various sources: La Crosse, 21st, church spire demolished, six or seven houses badly damaged and a number of barns burned. Oakland, Wis., 21st, several buildings struck and burned. Port Washington, Wis., 21st, three boys, while crossing a bridge at a rapid gait, and elbow to elbow, were enveloped by a flash of lightning, instantly killing the two outside boys while the middle one was left uninjured. Richmond, Va., 13th, about eight miles from town a large tree was set on fire by electricity, and a shell which was lodged in the tree during the late war was exploded thereby with a deafening report. Carr Station, Col., 16th, a cow boy while riding his horse to seek shelter from the storm was instantly killed; his body was terribly disfigured and burned; the horse had its head split open and brains scattered about, while the remainder of the body was badly mangled; all the metalic portions of the saddle and bridle were burned off. On New York Bay, 15th, a small fishing schooner containing two ladies and one gentleman, had its mast shattered to splinters down to the step, without doing the slightest injury to the hull of the boat or its occupants; the heads of the ladies were within one foot of the mast when struck. Grafton, Ohio, 31st, in passing through the roof of a residence near one of its chimneys the electricity entered a room below where two little girls were playing. It struck one of them on the head and passed down the right side of her face and over her breast to her knees, leaving a mark about two inches wide and completely stripping off her clothing, which was torn into shreds; the child was instantly killed while her companion remained uninjured. Saugus, Essex Co., Mass., 21st, electricity entered the telegraph office upon a wire connected with the instruments, burning off the connections and completly destroying one of the wires; a lady who sat about two feet distant from the instrument table, copying a message, had her pen and penholder melted in her hand, the paper was scorched, the carpet burned, torn up and blackened and the room filled with smoke; there were several sharp cracking explosions, which were heard a considerable distance; the lady experienced no sensation, except a slight pain in her side nearest to the instruments, otherwise she was perfectly uninjured; the walls of the house were scorched and

blackened along the course pursued by the electricity. Concord, N. H., 21st, the wires in the Tele phone Exchange were completely burned out, stopping all communication with surrounding towns. Schuylkill and Columbia Co's, Pa., 29th, most violent thunder storm for years; several persons killed by lightning and many buildings along the course of the storm badly shattered or burned. Waunakee, Wis., 20th, most violent thunder storm for past 25 years; the electricity tore a hole about 6 by 4 feet in the roof of a house and, passing thence down the chimney, demolished every wire-screen door in the building without injuring the occupants; 26 pigs, lying under a tree 25 rods from the house, were instantly killed. Fremont, Ohio, 8th, three horses instantly killed in an open, treeless field. Chicago, 20th, house struck, tearing off the shingles and siding as though so much paper; the electricity appeared to envelop the whole building, knocking the chimney into sections, cracking the stove and demolishing the windows; one person instantly killed in a group of three and the others seriously stunned. Columbus, Ohio, 22nd, house struck, tearing the chimney to pieces and filling the rooms with soot; the inmates were not injured in the least. Delaware, Ohio, 22nd, at a point about 8 miles west of town, electricity passed down the chimney of a house, splintering several joists; then moving onward and down the sides of the building it entered the room below, tearing a bed into shreds; from here it passed to a cook stove in an adjoining room, breaking it into innumerable pieces, and passing thence to a man who stood near, ran down his arm and leg and disappeared through the floor, in which it left a large hole. This person complained afterwards of sharp pains passing from one leg to the other, and was unable to close his hand.

Atmospheric Electricity Interfering with Telegraphic Communication.—Fort Missoula, Mont., 19th; Umatilla, Or., 2nd, 19th, 29th; Phoenix, Ariz., 23rd; Camp Grant, 21st, 23rd; Fort Cummings, 11th; Concho, 1st, 11th, 15th; Fort Davis, 8th, and 16th; Decatur, 11th and 26th; Jacksboro, 1st, 15th; Fort Sill, 14th, 21st, 30th; Fort Mc Kavitt, 1st, 2nd, 14th; Eagle Pass, 1st; Castroville, 2nd, 16th; Uvalde, 16th, 17th; Bismarck, 18th 19th; La Crosse, 21st; Mason, 15th, 16th; Fredericksburg, 15th, 16th; Mount Washington, 16th, the electricity entered the printing office at the summit, scattering a case of type; it also burnt one of the wires in the telegraph office; in the Signal office it burnt the telephone wires, passed half way round the room, burning the wires in several places and scorching the woodwork.

Auroras.—The display of the 2d was the most widely observed of any reported during the month, the line of observation continuing westward from Sydney, N. S., to Bismarck, and northward from the 39th parallel to Duluth. The following stations reported, and generally between the hours of 9 p. m. and midnight: Halifax, N. S., Charlottetown, P. E. I., Toronto, Can., Gardiner, Me., Eastport, 9.15 to 11.30 p. m.; Portland, 9 p. m. until after midnight; New Haven, 9 p. m. until after midnight; Strafford, Vt., Contoocookville, N. H., Williamstown, Mass., Cambridge, Mass., Fall River, Mass., Springfield, Mass., Newport, R. I., 10 p. m. until after midnight; Freehold, N. J., Little Egg Harbor, N. J., Ithaca, N. Y., Sandusky, Ohio, Toledo, 10 p. m. until midnight; Detroit, 10 p. m. until after midnight; Grand Haven, 9.30 p. m. until after midnight; Madison, Wis., Mission House, Wis., Clinton, Ia., Ft. Madison, Ia., Duluth, 8.30 to 10.50 p. m.; Huron, Dak. Ty., 9.30 p. m. until after midnight; Bismarck, 10 p. m. until after midnight. The display of the 3d, a continuation, in most cases, of the 2d, was visible at scattering stations from Eastport westward to Yankton, and generally between midnight and 2 a. m.; Eastport, midnight to 2 a. m.; Newport, midnight to 1 a. m.; Grand Haven, midnight to 2 a. m.; Monticello, Iowa, midnight to 2.30 a. m.; Clear Creek, Nebr., midnight to 2 a. m.; Yankton, 8 to 9 p. m. Isolated displays were reported as follows: Westborough, Mass., 5th, 10.30 p. m.; Fall River, Mass., 6th, 15th; Newport, Vt., 29th; Madison Barracks, N. Y., 29th, 9.25 p. m.; Montreal, Can., 29th; Burlington, Vt., 22d, 10 to 11 p. m.; 23d, 9 to 11 p. m.; 29th, 10 p. m. to midnight; Toronto, Can., 28th, 29th; Halifax, N. S., 31st; Sydney, N. S., 24th, 25th; Fallsington, Pa., 21st, 31st; Vevay, Ind., 26th, 27th, (29th, 9.55 p. m.); St. Paul, Minn., 1st, 8.30 to 11 p. m.; 12th, 9 to 11.20 p. m.; 13th, 9 to 11 p. m.; Embarrass, Wis., 24th; St. Vincent, Minn., 12th, 9.40 p. m. until midnight; Ft. Stevenson, Dak., 17th.

Zodiacal Light.—Nashville, Tenn., 16th, 18th, 20th, to 23rd, 25th, 27th, to 31st, Monticello, Ia., 19th, 25th, 30th; Cambridge, Mass., 19th; Northport, Mich., 13th.

OPTICAL PHENOMENA.

Solar halos have been observed in the various districts on the following dates: New England, 3rd, 7th, 18th, 25th, 27th; Middle Atlantic states, 9th, 15th, 22nd, 29th, 30th; South Atlantic states, 6th, 7th, 29th; Florida, 12th and 30th; Eastern Gulf states, 30th; Texas, 14th; Ohio valley and Tennessee, 4th, 11th, 12th, 13th, 18th, 20th, 26th, 30th; Lower Lake region, 26th; Upper Lake region, 2nd, 3rd, 11th, 14th, 16th, 26th; Upper Mississippi valley, 13th; Missouri valley, 9th, 13th, 27th, 29th; Middle Slope, 11th 14th; Middle Plateau, 5th, 8th, 13th; Northern Pacific coast region, 24th, 29th.

Lunar halos have been observed in the various districts on the following dates: New England, 1st, 4th, 10th; Middle Atlantic states, 4th, 5th, 7th, 9th, 11th to 15th; South Atlantic states, 4th, 7th, 10th, 11th, 13th; Eastern Gulf states, 5th, 9th, 12th; Western Gulf states and Texas,

1st, 3rd to 9th, 11th, 14th, 20th; Ohio valley and Tennessee, 11th 13th, 14th, 15th, 16th, 19th, 24th; Lower Lake region, 7th, 10th to 13th, 15th; Upper Lake region, 12th, 14th; Upper Mississippi valley, 2d, 6th, 9th, 11th; Missouri valley, 1st, 9th, 14th; Southern Plateau, 7th 8th, 31st.

MISCELLANEOUS PHENOMENA.

Sunsets.—The characteristics of the sky at sunset as indicative of fair or foul weather for the succeeding twenty-four hours have been observed at all Signal Service stations. Reports from 183 stations show 5,625 observations to have been made, of which 28 were reported doubtful; of the remainder, 4,644, or 83.0 per cent., were followed by the expected weather.

Sun Spots.—The following record of observations, made by Mr. D. P. Todd, Assistant, has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent, Nautical Almanac Office, Washington, D. C:

Date—July, 1881.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots.	
1, 5 p. m.	1	2	0	0	1	2	6	45†	Many of the spots small.
2, 8 a. m.	0	0	0	0	0	0	6	40†	
3, 5 p. m.	1	5	0	5	1	5	7	35†	
4, 1 p. m.	0	0	1	5	0	0	6	25†	
5, 9 a. m.	2	10	0	0	0	0	8	35†	
6, 11 a. m.	0	0	1	5	0	0	6	25†	
8, 8 a. m.	1	10	1	5	1	5	6	30†	
9, 6 p. m.	0	6	1	1	0	6	5	35†	
10, 11 a. m.	1	1	0	0	1	1	5	35†	
11, 8 a. m.	0	0	0	0	0	0	5	30†	
12, 4 p. m.	0	0	0	0	0	0	4	25†	
14, 7 a. m.	0	0	0	5	0	0	4	20	
16, 10 a. m.	0	5	1	5	0	0	2	20†	
17, 12 m.	1	3	0	5	1	3	3	15	
18, 6 p. m.	1	3	0	5	0	0	4	13	
19, 11 a. m.	0	4	0	2	0	0	4	15	
21, 6 p. m.	1	5	1	5	1	2	4	15	
23, 8 a. m.	4	15	0	5	2	10	8	25†	
24, 9 a. m.	0	20†	1	5	0	0	7	40†	
25, 5 p. m.	0	25†	0	0	0	0	7	65†	Many of the spots small.
26, 9 a. m.	0	0	0	5	0	0	7	60†	Many of the spots small.
28, 8 a. m.	1	10	1	5	1	2	7	65†	Many of the spots small.
29, 8 a. m.	1	2	0	5	1	2	8	65†	Many of the spots small.
31, 10 a. m.	2	5	1	5	2	5	8	60†	

†Approximated. Faculæ were seen at the time of every observation

Mr. H. D. Gowey, at North Lewisburg, Ohio, reports: Spots observed every day during the month, most numerous, 1st; fewest 17th; largest, during the latter part of the month. Mr. D. Trowbridge, at Waterburg, N. Y., reports as follows: 1st, 5 groups, 9 spots, 1 group just appearing by solar rotation; 2nd, same as observed on 1st, 7 spots; 5th, 2 groups, 3 spots, 1 new group appeared by solar rotation; 6th, 3 groups, 7 spots, 1 group near the middle of the disk, not seen on the 5th; 9th, 5 groups, 6 spots, 1 group just appeared by rotation; 11th, 3 groups, 7 spots, 2 were bright and large; 12th, 4 groups, 6 spots, 3 groups same as observed on 11th, and one new small spot; 13th, 4 groups, same as observed on 12th, 5 spots; 15th, 2 groups, 3 spots, 1 group disappeared by rotation and one gone out; 16th, 1 group, 4 spots, 1 group gone out; 18th, 3 groups, 3 spots, largest group observed on the 16th, has disappeared by rotation, 2 groups supposed to have appeared by rotation; 19th, 2 groups, 5 spots; 21st, 3 groups, 4 spots; 22d, 4 groups, 4 spots, 1 new group appeared by rotation; 24th, 5 groups, 8 spots; 25th, 4 groups, 13 spots, same groups as observed on 24th; 26th, 5 groups, same as 25th; 28th, 4 groups, 9 spots, cloudiness interfering with observation; 30th, 7 groups, 19th spots, 1 very fine group; 31st, 6 groups, 10 spots, some changes.

Published by order of the Secretary of War.

Brig. & Bvt. Maj. Gen'l,
Chief Signal Officer, U. S. A.

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II
III
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Breckenridge
Salt Lake City
Cheyenne
North Platte
Omaha
Denver
Santa Fe
Ft Gibson
Shreveport
Galveston
Indianola
San Francisco
San Diego
AVERAGE PROGRESS OF AREAS OF LOW BAROMETER EAST OF THE 100TH MERIDIAN.
No. | Velocity
I. 27.5 miles per hour.
II. 29 do.
III. 27.5 do.
IV. 21 do.
V. 24 do.
TRACKS OF CENTRES OF AREAS OF
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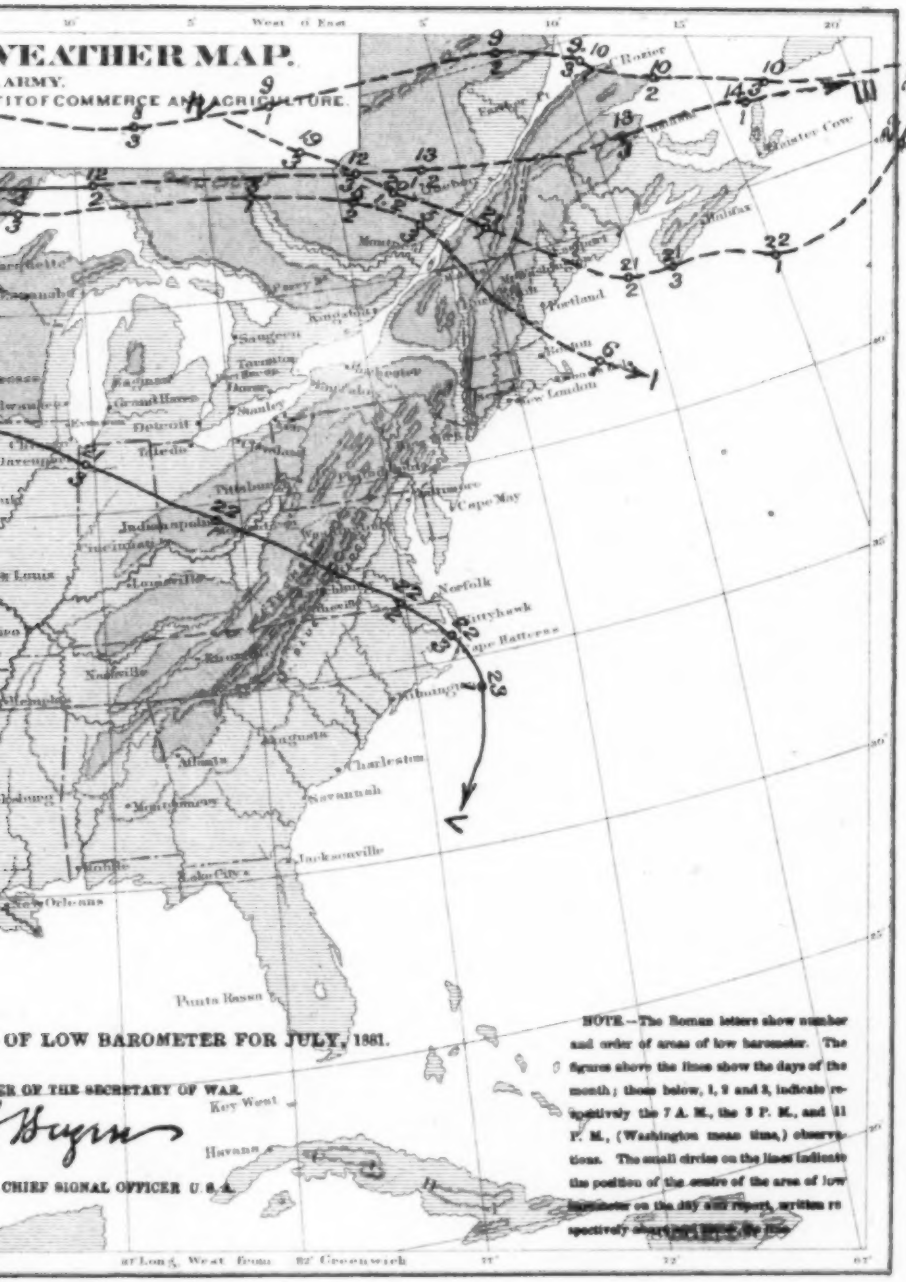
No. I.



OF LOW BAROMETER FOR JULY, 1881.

ER OF THE SECRETARY OF WAR.

CHIEF SIGNAL OFFICER U. S. A.

NOTE.—The Roman letters show number and order of areas of low barometer. The figures above the lines show the days of the month; those below, 1, 2 and 3, indicate respectively the 7 A. M., the 3 P. M., and 11 P. M., (Washington mean time,) observations. The small circles on the lines indicate the position of the centre of the area of low barometer on the day and report, written respectively above [illegible]

WAR DEPARTMENT WE
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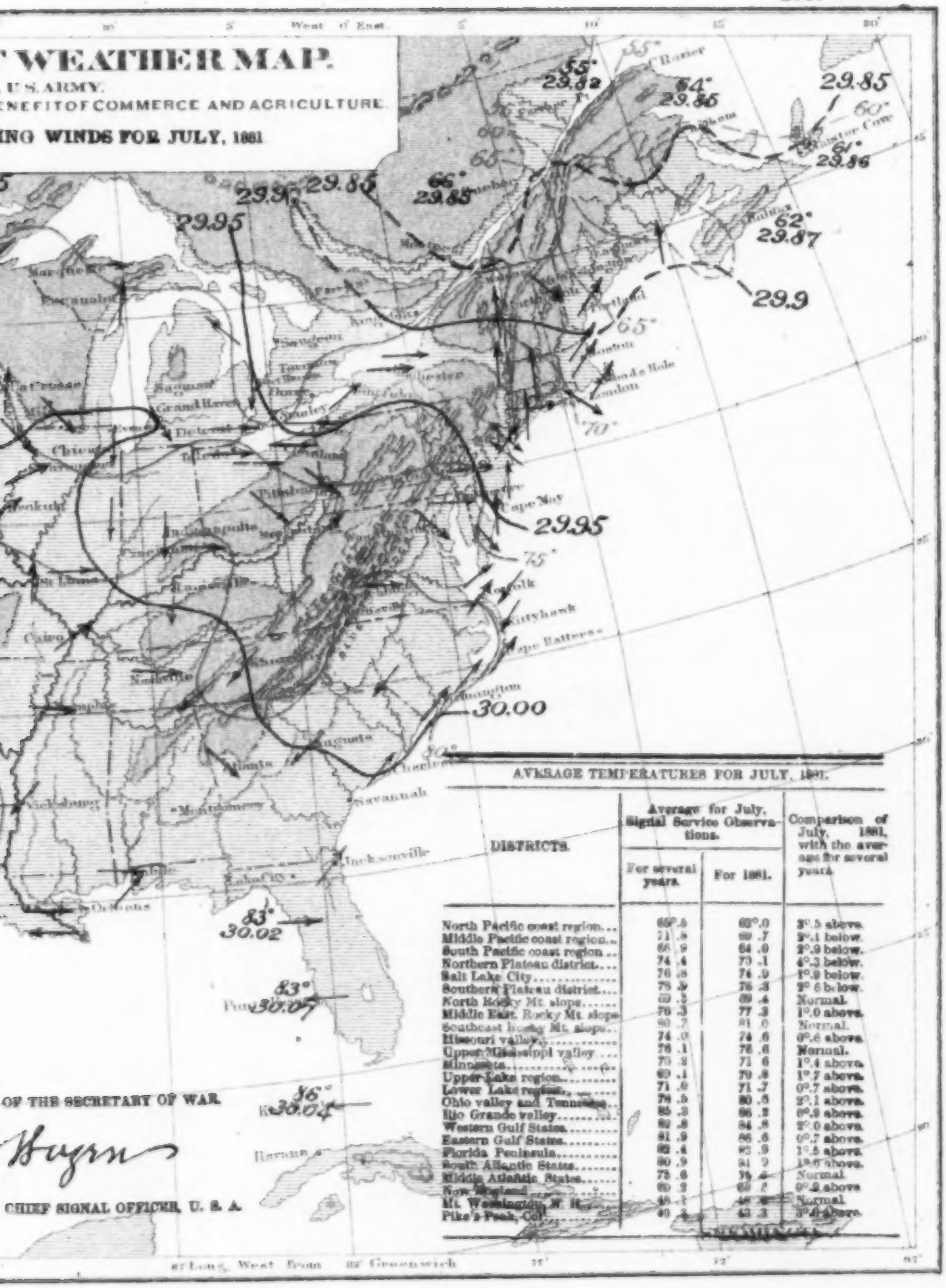
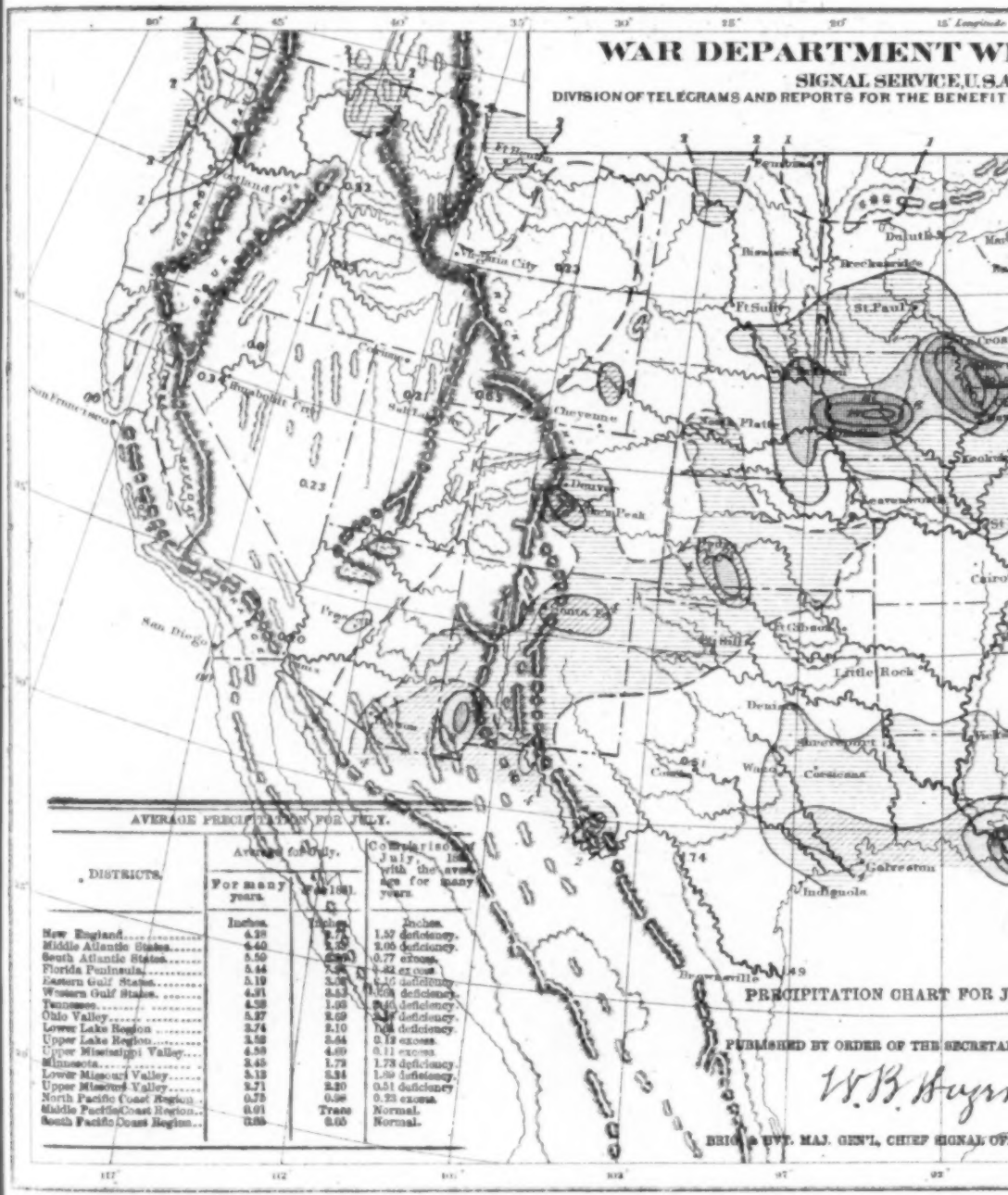
Milwaukee
Mobile
New Haven
New London
Newport
New York
New Shoreham
Norfolk
Tancasie
Portland, Maine
Portland, Or.
Port Eads
Punta Rassa
Sandusky
Sandy Hook
San Francisco
Savannah
Smithville
Thatcher's Island
Toledo
Wilmington
Woods' Holl
* Observations for only part of month—See text.

No. II.



AVERAGE TEMPERATURES FOR JULY, 1881.

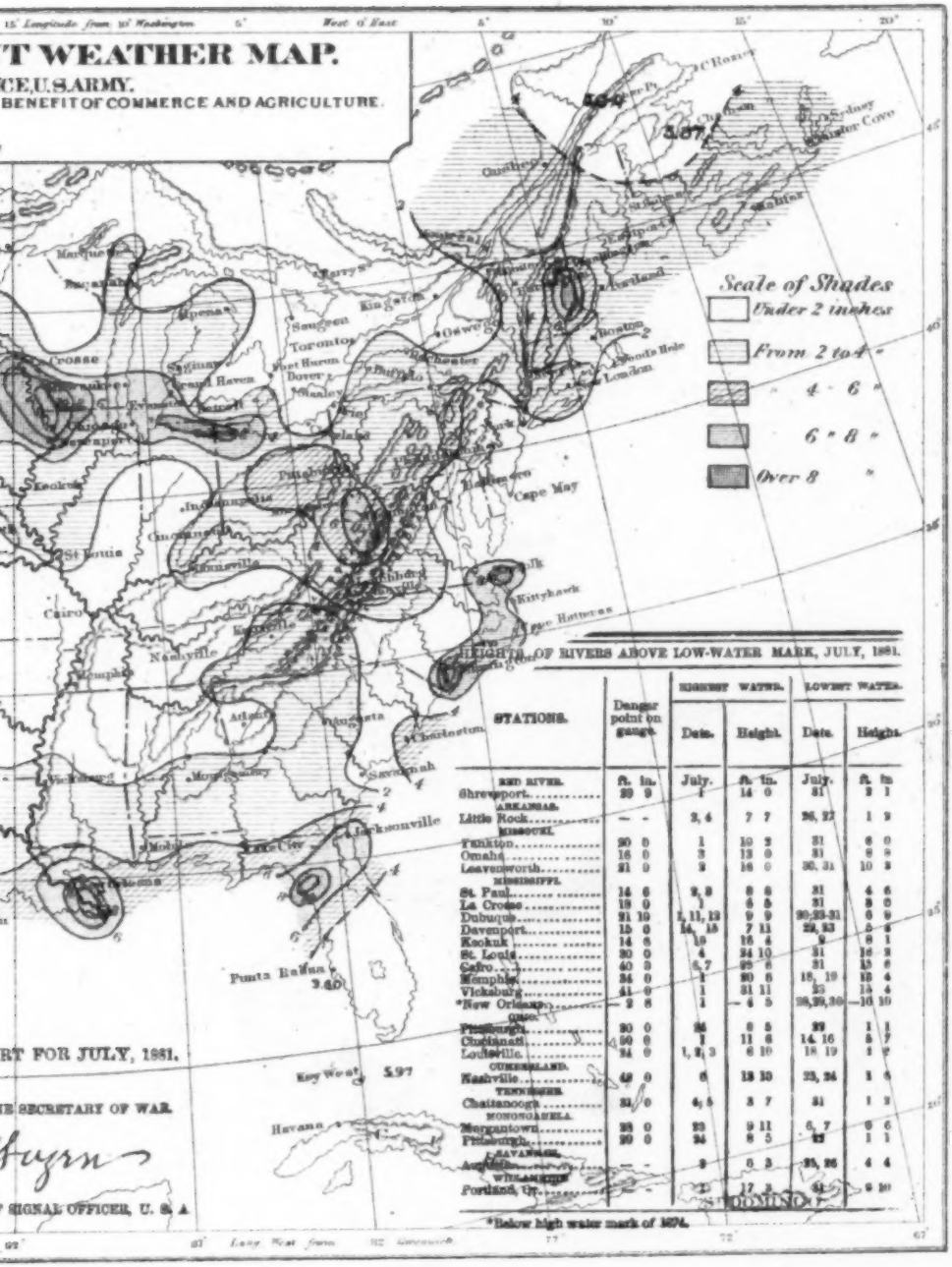
DISTRICTS.	Average for July, Signal Service Observations.		Comparison of July, 1881, with the averages for several years.
	For several years.	For 1881.	
North Pacific coast region	65°.5	68°.0	2°.5 above.
Middle Pacific coast region	71 .8	69 .7	2°.1 below.
South Pacific coast region	66 .9	64 .0	2°.9 below.
Northern Plateau district	74 .4	72 .1	2°.3 below.
Salt Lake City	76 .0	74 .0	1°.0 below.
Southern Plateau district	75 .5	76 .3	2°.6 below.
North Rocky Mt. slope	69 .5	69 .4	Normal.
Middle East. Rocky Mt. slope	76 .3	77 .3	1°.0 above.
Southeast Rocky Mt. slope	80 .7	81 .0	Normal.
Missouri valley	74 .0	74 .6	0°.6 above.
Upper Mississippi valley	76 .1	76 .6	Normal.
Minnesota	70 .2	71 .6	1°.4 above.
Upper Lake region	69 .4	70 .9	1°.7 above.
Lower Lake region	71 .0	71 .7	0°.7 above.
Ohio valley and Tennessee	78 .5	80 .6	2°.1 above.
Rio Grande valley	85 .2	86 .2	0°.8 above.
Western Gulf States	82 .8	84 .8	2°.0 above.
Eastern Gulf States	81 .9	86 .6	0°.7 above.
Florida Peninsula	82 .4	83 .9	1°.5 above.
South Atlantic States	80 .9	81 .9	1°.0 above.
Middle Atlantic States	73 .6	73 .6	Normal.
New England	69 .2	69 .7	0°.5 above.
Mt. Washington, N. H.	43 .1	43 .1	Normal.
Pike's Peak, Col.	40 .2	43 .3	3°.1 above.



AVERAGE PRECIPITATION FOR JULY.

DISTRICTS.	Average for July. For many years.	Average for July. For 1881.	Comparison of July, 1881, with the average for many years.
	Inches.	Inches.	Inches.
New England	4.39	2.82	1.57 deficiency.
Middle Atlantic States	4.40	3.35	2.05 deficiency.
South Atlantic States	5.50	6.27	0.77 excess.
Florida Peninsula	5.44	7.26	1.82 excess.
Eastern Gulf States	5.19	3.03	2.16 deficiency.
Western Gulf States	4.91	3.13	1.78 deficiency.
Tennessee	4.58	1.93	2.65 deficiency.
Ohio Valley	5.37	2.69	2.67 deficiency.
Lower Lake Region	3.74	2.10	1.64 deficiency.
Upper Lake Region	3.52	3.64	0.12 excess.
Upper Mississippi Valley	4.58	4.69	0.11 excess.
Minnesota	3.45	1.72	1.73 deficiency.
Lower Missouri Valley	5.13	3.34	1.80 deficiency.
Upper Missouri Valley	3.71	3.20	0.51 deficiency.
North Pacific Coast Region	0.75	0.98	0.23 excess.
Middle Pacific Coast Region	0.01	Trace	Normal.
South Pacific Coast Region	0.05	0.05	Normal.

U.S.B. Hazen



HEIGHTS OF RIVERS ABOVE LOW-WATER MARK, JULY, 1881.

STATIONS.	Danger point on gauge.	HIGHEST WATER. Date.	HIGHEST WATER. Height.	LOWEST WATER. Date.	LOWEST WATER. Height.
RED RIVER.	ft. in.	July.	ft. in.	July.	ft. in.
Shreveport	20 0	1	14 0	31	2 1
ARKANSAS.					
Little Rock	— —	2, 4	7 7	26, 27	1 9
MISSOURI.					
Yankton	20 0	1	10 2	31	6 0
Omaha	16 0	3	13 0	31	2 2
Leavenworth	21 0	3	16 0	30, 31	10 3
MISSISSIPPI.					
St. Paul	14 6	2, 3	8 6	31	4 6
La Crosse	19 0	1	4 6	31	3 0
Dubuque	21 10	1, 11, 12	9 9	30, 23-31	6 9
Davenport	15 0	14, 15	7 11	22, 23	5 4
Keokuk	14 6	19	16 4	2	0 1
St. Louis	30 0	4	24 10	31	16 2
Cairo	40 3	6, 7	28 6	31	15 6
Memphis	34 0	1	20 6	18, 19	13 4
Vicksburg	41 0	1	31 11	23	15 4
*New Orleans	— 2 6	1	— 4 5	28, 29, 30	—10 10
OHIO.					
Pittsburgh	30 0	24	6 5	29	1 1
Cincinnati	50 0	1	11 6	14, 16	5 7
Louisville	24 0	1, 2, 3	6 10	18, 19	1 2
CUMBERLAND.					
Nashville	40 0	6	13 10	23, 24	1 6
TENNESSEE.					
Chattanooga	31 0	4, 5	3 7	31	1 2
MONONGAHELA.					
Morgantown	25 0	23	9 11	6, 7	0 6
Pittsburgh	30 0	24	8 5	29	1 1
SAVANNAH.					
Augusta	— —	3	6 3	25, 26	4 4
WILLAMETTE.					
Portland, Or.	— —	21	17 3	31	9 10

*Below high water mark of 1874.

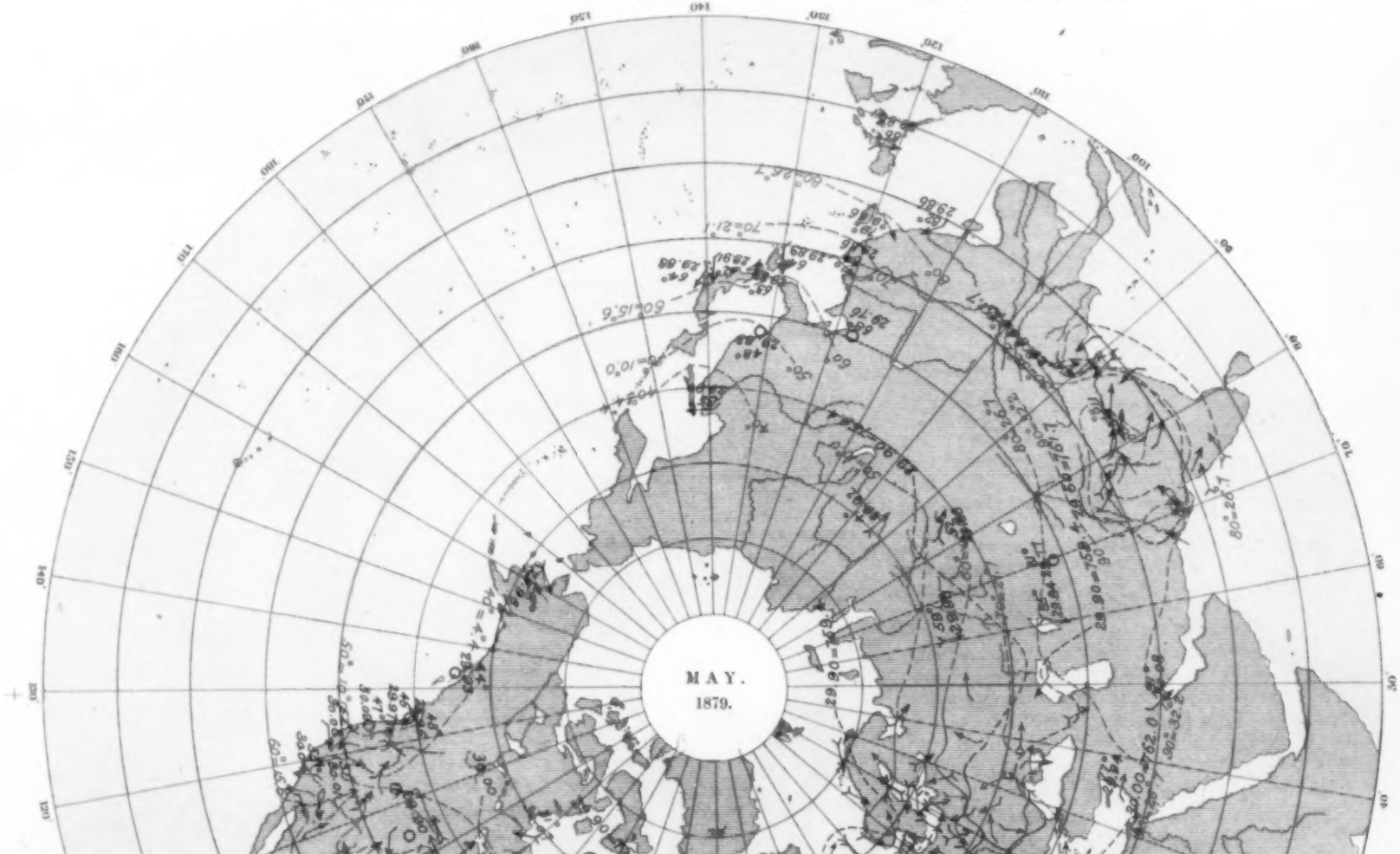
ST. DOMINGO

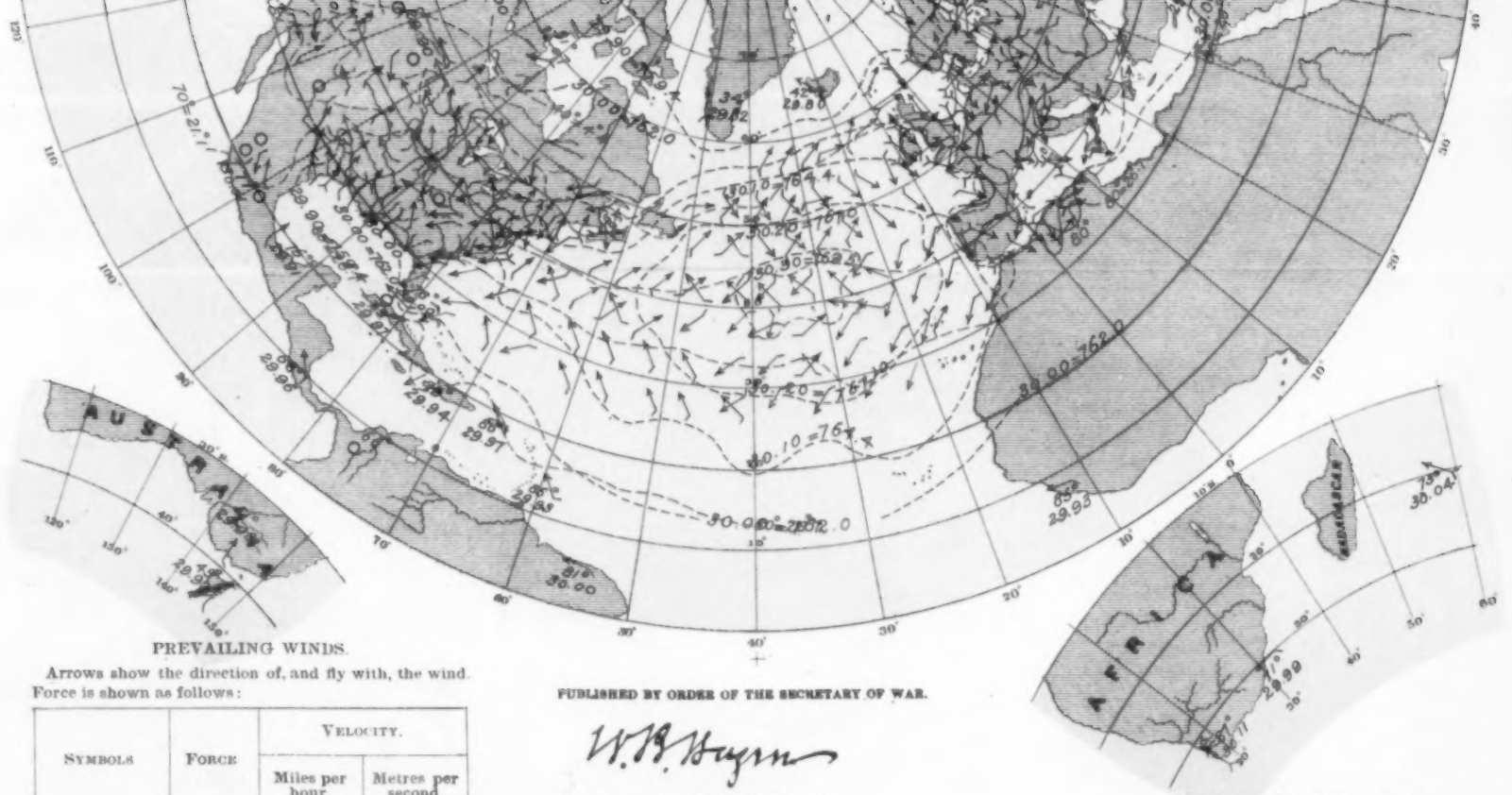
Office of the Chief Signal Officer,

UNITED STATES ARMY

Charted from Actual Observations taken Simultaneously. Series commencing January, 1877.

No. V.





PREVAILING WINDS.

Arrows show the direction of, and fly with, the wind. Force is shown as follows:

Symbols	Force	Velocity.	
		Miles per hour.	Metres per second.
○	0	0	0
→	1, 2	0 to 9	0 to 4.0
→	3, 4	9.1 to 22.5	4.1 to 10.1
→	5, 6	22.6 to 40.5	10.1 to 18.1
→	7, 8	40.6 to 67.5	18.1 to 30.2
→	9, 10	67.6 up.	30.2 & over.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

W. B. Hazen

Brig. & Bvt. Maj. Gen'l,
Chief Signal Officer, U. S. A.

ISOBARS AND ISOTHERMS.

Isobars in *blue*; detached barometer means in English inches.

Isotherms in *red*; detached temperature means in degrees Fahrenheit.

Broken lines, are doubtful.

INTERNATIONAL MONTHLY CHART.

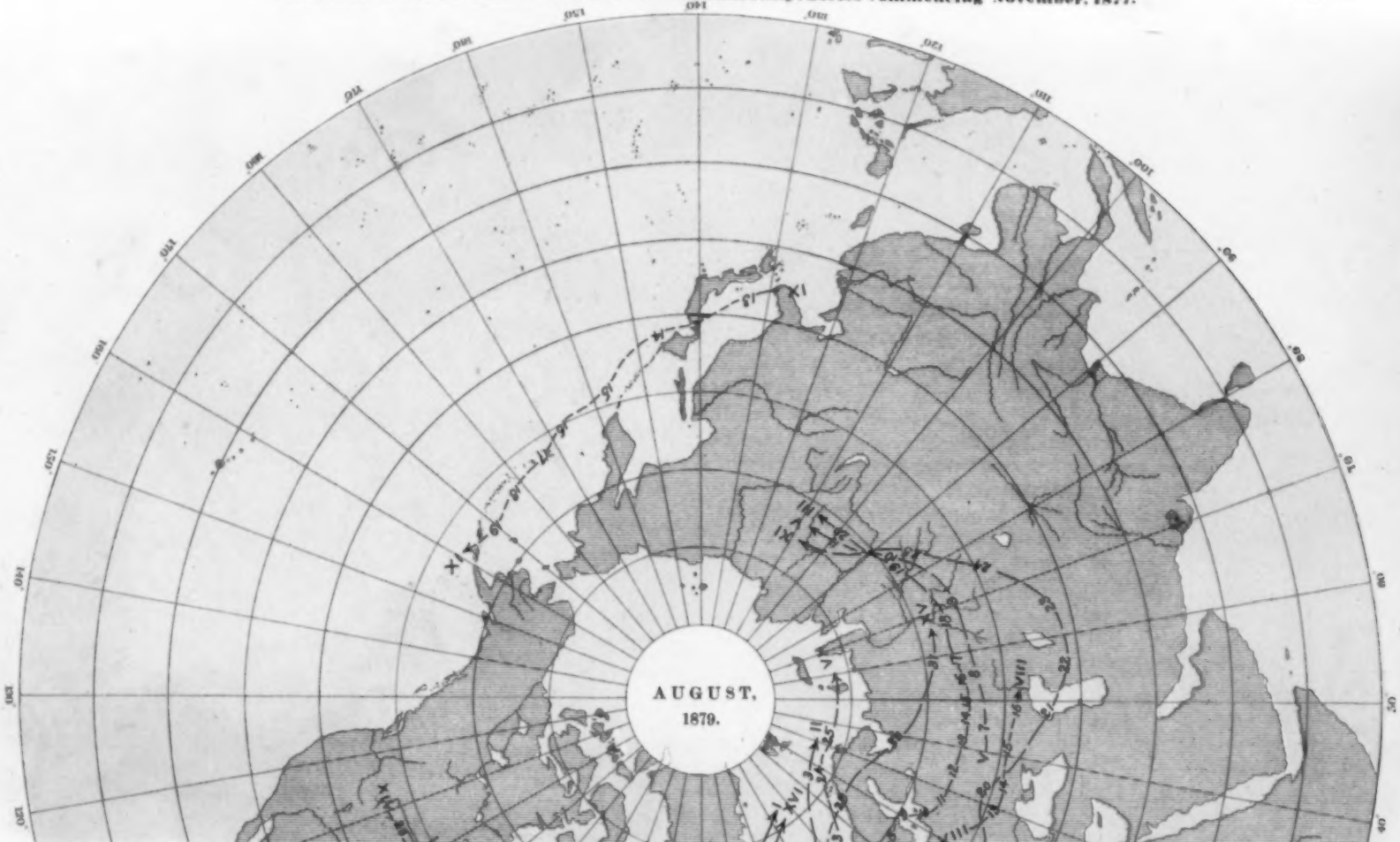
Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of May, 1879, based on the daily charts of the International Bulletin

Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously. Series commencing November, 1877.

No. VI.



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Chief Signal Officer, U. S. A.

Storm-tracks in *Black*. The Arabic numerals show location of the centres of Low Barometer, at 7:35 A. M., Washington mean time, of that date.

Broken or dotted lines, are doubtful.

INTERNATIONAL CHART.

Showing Tracks of Centres of Low Barometer for August, 1879.

CHART No. 5, (International Monthly C
REVIEW, will be found with the "Summar
ous Meteorological Observations" for the n
panying.

athly Chart, showing means) of this
Summary of International Simultane-
or the month of August, 1880, accom-